SYSTRON DONNER

INSTRUCTION MANUAL

MODEL 7205

DIGITAL MULTIMETER

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SYSTRON DONNER

A MEMBER OF THE THORN EMI GROUP

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CHAPTER 1
GENERAL INFORMATION

1.1 INTRODUCTION

The Model 7205 Digital Multimeter is a small, precision, 5-1/2 digit laboratory multimeter which combines the convenience of exceptional display readability and Accu-Ohm resistance measurements with the performance of a complete function multimeter and 5-1/2 digit accuracy.

The high readability display includes a large 0.55" high, seven-segment, in-line, in-plane display with positive indication (entire display cycles off and on) for out-of-range measurements, and positive indication of incompatible function and range combinations.

Accu-Ohm Resistance measurement is another convenience feature which allows making 2-wire resistance measurements with the accuracy equivalent to that of far more costly 4-wire systems. A front panel control allows lead resistance and connection thermal offsets to be nulled to zero. Thus, compensation is provided for the entire connecting system except for the actual point of contact to the component under test. When changing ranges there is no need to re-zero since proper null compensation is automatically provided in conjunction with the range switch.

The performance features 26 measuring ranges for five functions. The ten DC ranges permit voltage measurements from 1 μV to 1000 V and current readings from 1 nA to 1.3 A. The ten AC ranges allow readings from 10 μV to 500 V and 10 nA to 1.3 A. Resistance can be measured in six ranges from 1 kΩ to 13 MΩ.

As a precision 5-1/2 digit Multimeter this instrument features: a full scale voltage drop of 0.1 V on all current ranges to minimize distortion to true circuit current, ultra-low sense currents for resistance measurements which protect the components under test, 1000 V protection on all DC voltage ranges, 1000 MΩ input impedance on a number of DC voltage ranges to prevent circuit loading effects, and DC voltage resolution to ±1 μV. Other features include conservative design for long instrument life, MOS/LSI circuitry, ultra-stable resistors, and a certified reference zener ensuring long-term calibration stability.

1.2 SPECIFICATIONS

DC VOLTS

Ranges:	±.100000 V, ±1.00000 V, ±10.0000 V, ±100.000 V, ±1000.00 V

DC VOLTS (Cont'd)

Resolution:	±1 μV to ±0.01 V in decade steps (depending on range).
Overrange:	30% on all ranges except 1000 V range. Maximum readings are ±.130000 V, ±1.30000 V, ±13.0000 V, ±130.000 V and ±1000.00 V at full accuracy.
Polarity Selection:	Automatic with plus and minus indicator.
Input Impedance:	>1000 MΩ on .1, 1, and 10 V ranges; 10 MΩ on 100 and 1000 V ranges.
Accuracy:	1, 10, 100, and 1000 V ranges (+23 ±5°C): ±0.003% rdg. ±0.002% f.s. for 24 hours (+23 ±1°C), ±0.007% rdg. ±0.002% f.s. for 30 days, ±0.01% rdg. ±0.003% f.s. for 90 days, Add ±0.05 ppm/V on 1000 V range. 0.1 V range (+23 ±1°C):* ±0.005% rdg. ±0.005% f.s. for 24 hours, ±0.007% rdg. ±0.007% f.s. for 30 days, ±0.01% rdg. ±0.01% f.s. for 90 days.
Temperature Stability:	1, 10, 100, and 1000 V ranges (0 to +18°C; +28 to +50°C): (±0.001% rdg. ±0.0003% f.s.)/°C. 0.1 V range (0 to 50°C): (±0.001% rdg. ±0.0015% f.s.)/°C.
Full-Scale Step Response:	<1 second to rated accuracy.
Normal Mode Noise Rejection:	>80 dB at 50 and 60 Hz.
Common Mode Noise Rejection:	>140 dB at dc; >120 dB at 50 and 60 Hz with 1 kΩ source unbalance.
Maximum Input:	±1000 V dc on any range without damage.
Offset Current:	<±10 pA (10×10^{-12} A) on any range (+23 ±5°C).

* Specifications shown are maintained with no adjustment. Substantially

DC VOLTS (Cont'd)

improved accuracy for 100 mV range may be obtained with periodic re-zeroing of front panel DC ZERO control which also is designed to offset effects of low-level thermals in measuring leads and cables.

DC CURRENT

Ranges:	±.100000 mA, ±1.00000 mA, ±10.0000 mA, ±100.000 mA, ±1000.00 mA.
Resolution:	±1 nA to ±0.01 mA in decade steps (depending on range).
Overrange:	30% on all ranges. Maximum readings are ±.130000 mA, ±1.30000 mA, ±13.0000 mA, ±130.000 mA, and ±1300.00 mA at full accuracy.
Polarity Selection:	Indication is automatic with plus and minus indicator.
Configuration:	Overload protected, Kelvin shunt system is internal to instrument.
Accuracy:	(90 days, +23 ±5°C): 0.1, 1, and 10 mA ranges: ±0.12% rdg. ±0.02% f.s. 100 and 1000 mA ranges: ±0.15% rdg. ±0.02% f.s.
Temperature Stability:	0.1, 1, and 10 mA ranges (0 to +18°C, +28 to +50 °C): (±0.002% rdg. ±0.002% f.s.)/°C. 100 and 1000 mA ranges: (±0.004% rdg. ±0.002% f.s.)/°C.
Full Scale Step Response:	<1 second to rated accuracy.
Normal Mode Noise Rejection:	Same as dc volts.
Common Mode Noise Rejection:	Same as dc volts.
Maximum Input:	All ranges are protected by a Zener and fuse combination: ±1000 mA range, 2A fuse; ±100 mA range, .25A fuse. All ranges below 100 mA protected to >100 mA without blowing fuse.

DC CURRENT (Cont'd)

Voltage Drop:	0.1 V at full scale.

AC VOLTS

Ranges (rms value):	.10000 V, 1.0000 V, 10.000 V, 100.00 V, 1000.0 V (least significant digit blanked).
Resolution:	10 µV to 0.1 V in decade steps (depending on range). Internal jumper may be removed to add a decade of resolution on all ranges.
Overrange:	30% on all ranges except 1000 V range. Maximum readings are .13000 V, 1.3000 V, 13.000 V, 130.00 V and 500.00 V rms at full accuracy.
Input Impedance:	>1 MΩ shunted by <100 pF.
Accuracy:	See Table 1.1.
Temperature Stability:	1 and 10 V ranges (to 100 kHz), 100 V range (to 40 kHz), 1000 V range (to 10 kHz) (0 to +18°C, +28 to 50°C): (±0.005% rdg. 0.002% f.s.)/°C. .1 V range (to 100 kHz): (±0.005% rdg. 0.02% f.s.)/°C.
Full Scale Step Response:	<2 seconds to rated accuracy.
Maximum Input (without damage):	10, 100, and 1000 V ranges: 700 V rms. 0.1 and 1 V ranges: 250 V momentary (<5s), 150 V rms continuous.
Conversion Method:	Full wave averaging, scale factored to rms.

AC CURRENT

Ranges (rms value):	.10000 mA, 1.0000 mA, 10.000 mA, 100.00 mA, 1000.0 mA.

TABLE 1.1 AC VOLTAGE ACCURACY (INPUT LEVEL >1% OF RANGE)
(90 DAY SPECIFICATIONS 23°C ±5°C)

Range	20 Hz- 50 Hz	50 Hz- 10 kHz	10 kHz 15 kHz	15 kHz 40 kHz	40 kHz 60 kHz	60 kHz 100 kHz
.1 V	±0.4% rdg. ±0.15% f.s.	±0.1% rdg. ±0.15% f.s.			±0.1% rdg. ±0.25% f.s.	±0.1% rdg. ±0.35% f.s.
1 V	±0.4% rdg. ±0.02% f.s.	±0.1% rdg. ±0.02% f.s.			±0.1% rdg ±0.03% f.s.	±0.1% rdg. ±.04% f.s.
10 V	±0.5% rdg. ±0.02% f.s.	±0.2% rdg. ±0.02% f.s.			±0.2% rdg. ±0.03% f.s.	±.2% rdg. ±.04% f.s.
100 V	±0.5% rdg. ±0.02% f.s.	±0.2% rdg. ±0.02% f.s.			±0.7% rdg. ±.03% f.s.	
1000 V * (500 V max. input)	±0.5% rdg. ±0.02% f.s.	±0.2% rdg. ±0.02% f.s.	±0.7% rdg. ±0.03% f.s.			

* 500 V rms maximum input. Add .2 ppm/V kHz on 1000 V range.

Specifications shown are maintained with no adjustment. Substantially improved accuracy for .1 V range may be obtained with periodic rezeroing of front panel AC NULL control.

AC CURRENT (Cont'd)

Resolution:	10 nA to 0.1 mA in decade steps (depending on range). Internal jumper may be removed to add additional decade of resolution on all ranges.
Overrange:	30% on all ranges. Maximum readings are .13000 mA, 1.3000 mA, 13.000 mA, 130.00 mA, and 1300.0 mA.
Configuration:	Overload protected, Kelvin shunt system is internal to instrument.
Accuracy:	See Table 1.2
Temperature Stability:	(0 to +18°C, +28 to +50°C): All ranges: (±0.005% rdg ±0.02% f.s.)/°C.
Full Scale Step Response:	<2 second to rated accuracy.
Maximum Input:	All ranges protected by a Zener and fuse combination. 1000 mA range, 2A fuse: 100 mA range, .25A fuse. All ranges below 100 mA protected to >100 mA without blowing fuse.
Voltage Drop:	0.1 V at full scale.

RESISTANCE:

Range	Current thru Rx	Resolution (Ω)	Full Scale Drop (V)
.100000 kΩ(.1)	1 mA	0.001	0.1
1.00000 kΩ(1)	1 mA	0.01	1.0
10.0000 kΩ(10)	0.1 mA	0.1	1.0
100.000 kΩ(100)	10 µA	1.0	1.0
1000.00 kΩ(1000)	1 µA	10.0	1.0
10.0000 MΩ(10M)	1 µA	100.0	10.0

Overrange:	30% on all ranges. Maximum readings are .130000 kΩ, 1.30000 kΩ, 13.0000 kΩ, 130.000 kΩ, 1300.00 kΩ, and 13.0000 MΩ.
Configuration:	Two wire measurement system with convenient front panel adjustment to compensate for all system connections and lead resistances up to point of termination to unknown resistance.

TABLE 1.2 AC CURRENT ACCURACY (INPUT LEVEL >1% OF RANGE)
(90 DAY SPECIFICATION 23°C ±5°C)

RANGE	20 Hz- 50 Hz	50 Hz- 10 kHz	10 kHz- 20 kHz	20 kHz- 40 kHz
.1	±0.6% rdg ±0.15% f.s.	±0.3% rdg ±0.15% f.s.	±0.6% rdg ±0.2% f.s.	
1	±0.6% rdg ±0.15% f.s.	±0.3% rdg ±0.15% f.s.		±0.6% rdg ±0.2% f.s.
10	±0.6% rdg ±0.15% f.s.	±0.3% rdg ±0.15% f.s.		±0.6% rdg ±0.2% f.s.
100	±0.6% rdg ±0.2% f.s.	±0.3% rdg ±0.15% f.s.	±0.6% rdg ±0.2% f.s.	
1000	±0.6% rdg ±0.2% f.s.	±0.3% rdg ±0.15% f.s.	±0.6% rdg ±0.2% f.s.	

RESISTANCE (Cont'd)

Lead Compensation Range:	>0.5 Ω normally adjusted on 100 Ω range. Does not require readjustment on 1 kΩ and 10 kΩ ranges.
Accuracy:	(90 days, +23 ±5°C), 1 kΩ, 10 kΩ, and 100 kΩ ranges: ±0.01% rdg ±0.003% f.s. 1000 kΩ range: ±0.02% rdg ±0.003% f.s. 10 MΩ range: ±0.05% rdg ±0.003% f.s. .1 KΩ range (+23 ±1°C): ±0.02% rdg ±0.01% f.s. * Front panel lead compensation control allows readjustment of zero (.1 KΩ range only) to ±0.003% of full scale at any time between calibration intervals.
Temperature Stability:	(0 to +18, +28 to +50°C), 1 kΩ, 10 kΩ, and 100 kΩ ranges: (±0.001% rdg ±0.0003% f.s.)/°C. 1000 kΩ range: (±0.002% rdg ±0.0004% f.s.)/°C. 10 MΩ range: (±0.005% rdg ±0.001% f.s.)/°C. .1 KΩ range (0 to +50°C): (±0.002% rdg ±0.002% f.s.)/°C.
Full Scale Step Response:	(In seconds) On all ranges = 0.4 + [0.9 X Resistance in Meg Ω].
Maximum Open Circuit Voltage at Input Terminals:	All ranges except 10 MΩ: <15 V, 10 MΩ range: <18 V.
Voltage Protection:	(without fuse replacement or damage): >250 V rms on all ranges except, >150 V rms on .1 kΩ, 1 kΩ and 10 kΩ ranges.

GENERAL

Display:	The 5 full digit display plus overrange digit consisting of 0.55" high, in-line, in-plane, seven segment, gas discharge tubes includes automatic decimal point positioning for all functions and ranges, automatic positive and negative polarity indicator for

GENERAL (Cont'd)

	all dc functions and ranges, display storage for non-blinking readout, entire display cycles off and on automatically to provide off-scale indication, and positive display indication of excluded function and range.
Display Expansion:	Least significant digit is automatically blanked for all ac measurements to eliminate digits outside of accuracy range. Full 5 digit plus overrange display may be restored by removing internal circuit-board jumper thereby increasing resolution by a factor of 10 for comparison measurements.
Sample Rate:	Nominal 2.5 rdg/s. Option 05 (BCD output) provides variable data transfer rate and remote data transfer capability.
Input Configuration:	Fully floating and guarded in all functions.
Maximum Common Mode Voltage:	±500 V dc or peak ac.
Range Selection:	Manual by front panel pushbuttons.
Warmup Time:	1 hour to full specifications. 20 min with some accuracy degradation.
Operating Temperature:	0 to +50°C.
Relative Humidity:	0 to 80% (0 to +35°C); 0 to 75% (+35 to +50°C).
Dimensions:	3-1/2" H X 8-1/2" W X 13" D. Half-rack size portable package including two side carry handles.
Weight:	<10 lb. (4.5 Kg) net; 15 lb. (6.8 Kg) Shipping.
Power:	100/115/200/230 V ac; rear panel switch selectable 100/200 V ac 115/230 V operation, 48-440 Hz, <10 W.

GENERAL (Cont'd)

OPTIONS

05 Digital Output*:	Parallel 8-4-2-1 BCD outputs of all measurement data including function and decimal point. Single output lines (true state active) provided for polarity, print command and offscale. Outputs are optically isolated from input signal. Logic levels are DTL/TTL compatible, positive true or negative true selectable. HIGH LEVEL: +2.4 to +5 V, 0.1 mA source. LOW LEVEL: 0 to +0.5 V, 1.8 mA sink.
Inputs:	Single line (positive or negative true selectable) for external command to RECORDER BUSY (inhibit) input.
Data Transfer Rate:	Remote TRANSFER-ON-DEMAND, or automatic transfer with rate variable by rear panel adjustment from nominal 2.5/s to <1/5 s.

* Must be installed by factory or authorized service center.

ACCESSORIES

Leather Carry Case, P/N 37724

Protective Snap-Off Cover, P/N 37229-4

Input Test Leads, P/N 37232-1

Single Rack Mount Kit, P/N 45410-3

Dual Rack Mount Kit, P/N 37492

Solid-Jaw, Gold Plated Test Leads
For Low-Loww Resistance Measurements

High Voltage Probe, P/N 37316

CHAPTER 2
INSTALLATION

2.1 INTRODUCTION

The Model 7205 Digital Multimeter is shipped in an operational condition and is essentially ready for use as received. This chapter outlines the procedures for initial inspection and installation of the instrument. Instructions for reshipment are also included should the unit be returned to Systron-Donner Corporation for service or repair.

2.2 RECEIVING INSPECTION

Prior to accepting the meter from the shipper, inspect the condition of the shipping container for any indication of freight damage. Any sign of such damage must be noted by both the shipper and receiver and should be reported to the insurance investigator.

Immediately following removal of the instrument from the shipping carton, inspect for possible physical damage incurred during shipment. Check surfaces for scratches or dents and note condition of knobs and connectors. Should any damage be noted, notify your nearest Systron-Donner representative---DO NOT USE THE METER UNTIL INSTRUCTED TO DO SO BY THE REPRESENTATIVE.

2.3 RESHIPMENT

When the instrument is to be repackaged for shipment use the original packing materials. Your Systron-Donner field office can provide materials similar to those used for the original factory packaging, or repackage the instrument following these general instructions:

GENERAL PACKING INSTRUCTIONS

1) Attach a tag to the unit indicating the model number, serial number, name and address of the instrument owner, and a summary of the service or repairs required.

2) Wrap the instrument in heavy paper or plastic prior to placing it into the shipping container.

3) Select a strong carton or wooden box to house the instrument.

4) Use an adequate layer of shock-absorbing material on all sides of the instrument and protect the front panel with additional layers of cardboard. Be certain that there is no movement of the unit within the container.

5) Seal the package with strong tape or metal bands.

6) Mark the shipping container "FRAGILE-DELICATE INSTRUMENT" to ensure careful handling.

7) Be certain that all correspondence refers to full instrument nomenclature (model, serial number, sales order and date).

2.4 POWER REQUIREMENTS

Model 7205 Digital Multimeter is equipped with a standard three-conductor power cord which, when plugged into an appropriate power receptacle, grounds the chassis to protect operating personnel from certain electrical hazards. Whenever the power cord is mated to a two-conductor outlet, a cord adapter-plug (properly installed) will provide the same protection.

The instrument operates from either 115 or 230 V at 48 to 440 Hz and consumes approximately 10 watts of power. A LINE switch on the rear panel adapts the unit for the local power line voltage. A 100/200 V tap on the primary of the power transformer is also provided to accommodate certain other power line requirements.

NOTE

The Model 7205 is shipped with a 1/4 ampere fuse Slo-Blo (115 V operation). If 230 V operation is required, the 1/4 ampere fuse should be replaced with a 1/8 ampere Slo-Blo fuse to adequately protect the meter.

2.5 ACCEPTANCE TEST PROCEDURE

The following procedure is performed to verify that no damage has occurred during transit and that the instrument is operative.

NOTE

Prior to performing the Acceptance Test Procedure it is recommended that the user become familiar with the instrument controls described in Section 3, OPERATION.

1) Check position of the LINE (115/230 V or 100/200 V) switch and connect ac power cord to an appropriate power source.

2) Turn POWER switch to the ON position; the display will illuminate. Allow one hour warmup.

3) Select controls indicated in Table 2.1 and observe the display readings.

TABLE 2.1 ACCEPTANCE TEST PROCEDURE

FUNCTION	RANGE	INPUT	DISPLAY
V	1000	HI,LO,GUARD SHORTED	< ±0000.02
V & AC	1000	" " "	< 0000.2
mA	1000	" " "	< ±0000.20
mA & AC	1000	" " "	< 0001.5
KΩ	1000	" " "	< 0000.03
KΩ	1000	HI,LO OPEN	OFFSCALE READING WITH FLASHING DISPLAY.

4) After completion of the Acceptance Test Procedure, refer to Section 3, OPERATION for additional operating information

CHAPTER 3
OPERATION

3.1 INTRODUCTION

This chapter describes the operation of the Model 7205 Digital Multimeter. Front panel and rear panel functions are described in Tables 3.1 and 3.2. Operating procedures are given in Table 3.3. Also included is information concerning factors which affect measurement accuracy.

3.2 CONTROLS, CONNECTORS AND INDICATORS

3.2.1 Front Panel

Front Panel control functions for Model 7205 are described in this section (see Table 3.1).

TABLE 3.1 FRONT PANEL FUNCTIONS

NAME	FUNCTION
DC ZERO (screwdriver adjustment)	Fine (screwdriver) adjustment for zeroing the .1 V range when high-resolution accuracy is desired.
POWER OFF-ON (switch)	Applies power to the instrument when turned in the clockwise direction to the ON position.
FUNCTION (pushbutton switches)	Pushbutton switches, AC (red), V, mA, and KΩ, initiate the following measurements: FUNCTION — PUSHBUTTON dc voltage — depress V (press off AC) dc current — depress mA (press off AC) ac voltage — depress V & AC ac current — depress mA & AC resistance — depress KΩ (press off AC)
DISPLAY	
Excluded Range/Function (Indicator)	Excluded switch combination shown by flashing indicator at left of display.
Off-Scale (Indicator)	Display turns off and on when an off-scale condition exists.
Polarity (Indicator)	Positive and negative polarity dc measurements are indicated with a (+ or -) sign.

3.2.1 Front Panel (Cont'd)

NAME	FUNCTION
Readout (tubes)	Full five-digit display, with overrange (1), provides full scale readout and 30% overrange capability. Decimal point indication is determined by the range selected.
RANGE	Pushbutton switches select the following ranges:

RANGE	AC&DC VOLTS	AC&DC CURRENT	KΩ RESISTANCE
.1	X	X	X
1	X	X	X
10	X	X	X
100	X	X	X
1000	X	X	X
10 MΩ	No	No	X

Ω LEAD COMP (screwdriver adjustment)	For highly accurate resistance measurements, this adjustment potentiometer permits compensation for lead resistance on the .1 KΩ range, this adjustment also compensates the 1 KΩ and 10 KΩ ranges. Leads are shorted for adjustment.
HI, LO (post connectors)	Input terminals for all measurement functions.
GUARD (post connector)	Internal guard circuit may be left open (unconnected), or can be bussed to the LO terminal. It may also be connected to an external guard potential. The guard circuit, when utilized, provides increased ac and dc common mode rejection of spurious or undesired signal currents. For all ac measurements, the guard should be connected to LO.
AC NULL (screwdriver adjustment)	This allows nulling the .1 V AC range for more accurate low voltage measurements. A shorting bar or shielded leads should be used to short the input. Long unshielded leads will introduce noise pickup.

3.2.2 Rear Panel

Rear Panel control functions for Model 7205 are described in this section (see Figure 3.2):

TABLE 3.2 REAR PANEL FUNCTIONS

NAME	FUNCTION
FUSE (holder)	Contains 1/4 A 3AG Slo-Blo fuse for 115 V operation or a 1/8 A Slo-Blo fuse for 230 V operation.

3.2.2 Rear Panel (Cont'd)

NAME	FUNCTION
BCD (connector)	Option 05, Digital Outputs - provides isolated 8-4-2-1 BCD levels and DTL/TTL compatible recorder control logic levels.
PRINT RATE (screwdriver adjustment)	When the option 05 is installed and automatic transfer rate is selected, the rate may be varied with this potentiometer from a nominal 2.5/s to <1 sample/5 s.
AC POWER (three-conductor power receptacle)	Power receptacle mates with standard three-conductor power cord (supplied).
LINE (switch)	Slide switch selects 115/230 (±10%) V ac, 48 to 440 Hz operation. Power transformer tap (modification) converts unit to 100/200 (±10%) V ac operation.

3.3 OPERATING PROCEDURES

The general method for operating Model 7205 is indicated in Table 3.3. All inputs are applied between HI and LO terminals with the GUARD circuit connected to the LO terminal whenever possible, especially when in the AC Volts and AC Current functions.

TABLE 3.3 OPERATING PROCEDURES

FUNCTION	OPERATION	DISPLAY
DC VOLTS	Select V and desired RANGE .1, 1, 10, 100, or 1000.	Read display directly in dc volts.
DC CURRENT	Select mA and desired RANGE .1, 1, 10, 100, or 1000.	Read display directly in dc milliamperes.
AC VOLTS	Select V and AC with desired RANGE .1, 1, 10, 100, or 1000.	Read display directly in ac volts.
AC CURRENT	Select mA and AC with desired RANGE .1, 1, 10, 100, or 1000.	Read display directly in ac milliamperes.
RESISTANCE	Select KΩ and desired RANGE .1, 1, 10, 100, 1000, or 10 MΩ.	Read display directly in kilohms on the .1, 1, 10, 100, 1000 ranges, and in megohms on the 10 MΩ range.

3.3.1 Overrange Indication

If the display flashes off and on select a higher range until the flashing stops.

3.3.2 Guard Terminal

The instrument contains two isolated inner chassis (top and bottom guard covers) connected to the GUARD terminal on the front panel. With the GUARD/LO terminals bussed together, measurement errors due to ac or dc normal mode currents are reduced significantly. Although the GUARD terminal is usually bussed to the LO terminal, in certain applications it may be advantageous to connect it to a separate Guard Voltage.

3.3.3 Overload Protection

Overload protection is provided on all ranges to the extent indicated below:

1) DC VOLTS - ±1000 V (maximum allowable input) on all ranges.

2) AC VOLTS - 700 V rms on 10 V, 100 V, 1000 V ranges. 150 V rms on .1 V, 1 V ranges with 250 V rms for <5 s.

3) DC CURRENT - All ranges protected by a Zener and fuse combination; ±1000 mA range (2A fuse. ±100 mA range (.25A fuse). All ranges below 100 mA protected to >100 mA without blowing fuse.

4) AC CURRENT - All ranges protected by a Zener and fuse combination; ±1000 mA range (2A fuse), 100 mA range (.25A fuse). All ranges below 100 mA protected to >100 mA without blowing fuse.

5) RESISTANCE - >250 V rms on all ranges except 100 Ω and 1 KΩ >150 V rms on 100 Ω and 1 KΩ ranges.

3.3.4 DC Zero Adjustment

Located on the Model 7205 front panel is the DC ZERO adjustment. This control permits the user to accurately zero the instrument when low-level, high-resolution measurements are to be made on the .1 V range.

Before adjusting this control, allow the instrument to stabilize for at least 1 hour after turn-on. Connect a zero-ohm shorting buss across the HI and LO terminals and adjust the DC ZERO control until a reading of .000000 V ±3 counts is obtained.

3.3.5 AC NULL Adjustment

Located on the front panel is the AC NULL adjustment. This control permits the user to accurately null the instrument when low-level, high resolution measurements are to be made on the .1 V AC range.

Before adjusting this control, allow the instrument to stabilize for at least 1 hour after turn-on. Connect a zero-ohm shorting bus across the HI and LO terminals and adjust the AC NULL control for a low null reading.

3.3.6 Ω LEAD COMP Adjustment

This control is on the front panel and allows compensation for lead resistance measurements when in the .1 KΩ range. Allow at least 1 hour after turn-on for unit to stabilize then short the test leads together and adjust for .000000 KΩ ±3 counts. The .1 V DC range should be checked for proper zero before making this adjustment.

3.3.7 Expanded AC Display

To add the blanked, least significant digit when in AC, remove jumper on the readout board adjacent to A2U8. Full 5-1/2 digit display is only recommended for experienced personnel capable of full interpretation of the AC accuracy specifications. If a modified calibration procedure is adopted for reduced bandwidth, a significant improvement in reading accuracy over that specified may be achieved.

3.3.8 BCD Option 05, Output

The 05 option board provides optically isolated output information. All outputs are capable of driving most standard logic forms, including TTL, DTL, and low power RTL. Complete flexibility allowing a choice of positive-ture, or negative-true output levels, has been provided. The 32 lines of output data contain the following information:

1) Six decades of 1248 BCD information representing the measured value.
2) Three lines of 124 BCD information representing the selected RANGE.
3) Three lines of 124 BCD information representing the selected FUNCTION.
4) One line to indicate an OFF-SCALE, i.e., over 30% of range measurement.

   Logic 0 = ON-SCALE logic 1 = OFF-SCALE
5) One line to indicate the sign or polarity of the measurement. This line is normally in the Logic 1 state except for - DC V

or -DC mA measurements. Logic 0 = - polarity and Logic 1 = + polarity, or no polarity in AC or kΩ.

All 32 lines of data are normally positive-true, but may be inverted to negative-true simply by applying a low input to the Data Polarity Select line, pin 21 of P3 (connect pin 21 to BCD Ground, pin Z at the output connector, J3).

Control Signal Outputs

Two output lines are available to indicate when valid data is present at the 32 data output lines. The choice of the output line to use will depend on the external system requirements. The two outputs are as follows:

1) PRINT COMMAND PULSE: (Pin E) An output occurs at the end of a data transfer into the parallel buffer storage, consisting of Quad D flip-flops U17 through U24. The output pulse is from a buffered one-shot circuit and is approximately 25 milliseconds in duration. If the external data logging device has an edge sensitive or AC coupled input, the leading edge may be used for an undelayed command, or the trailing edge for a delayed command. The output level is normally low and goes high for approximately 10 milliseconds. This output may be inverted by pulling the PRINT COMMAND POLARITY select line (Pin J of P3) low. Connect pin J of J3 to BCD GROUND, pin Z of J3.

2) VALID DATA LEVEL: This output is a DC level which is normally high except during the interval new data is being transferred into the buffer-storage flip-flops. This output may also be inverted by applying a low input to the VALID DATA POLARITY select line, (Pin H of P3). Connect pin H of J3 to BCD GROUND, pin Z of J3.

Control Signal Inputs

Two input lines allow selection of data transfer at a rate determined by the rear panel PRINT RATE control,or a single data transfer for each command from a remote source. Inhibiting a data transfer when operating under internal PRINT RATE control is also possible. The PRINTER INHIBIT input should be used when the external data processing item exceeds the time allowed at a particular PRINT RATE control setting. The PRINTER INHIBIT input is not required, if the PRINT RATE control is adjusted to produce a data transfer rate which is less than the maximum speed capability of the external printer, or data processor. The functions of the two input control lines are as follows:

Mode Select or Printer Inhibit: (P3 pin D)

a) A low input will inhibit new data transfers into the output buffber storage. Removing the inhibit input will allow a transfer at the end of the next valid measurement. The input logic level may be inverted by applying a low input to pin C of P3. Conenct pin C of J3 to BCD GROUND, pin Z of J3, if a high level inhibit

is required.

b) An inhibit input to pin D also selects the external TRANSFER ON COMMAND mode of operation which follows.

Transfer Command Input: (P3 pin B)

a) If input is applied to pin D of J3, a momentary low level applied to the TRANSFER COMMAND INPUT pin B of J3 will result in a single data transfer to the output buffer storage at the completion of the next valid measurement cycle. This line should be held low at least 10 s, and not more than 200 milliseconds if the external command source is a relay contact. Contact bounce may cause a false command. If the signal is free from bounce or false edges, the 200 millisecond maximum does not apply. The polarity of the input transition to create a TRANSFER COMMAND may be inverted by applying a low input to the TRANSFER POLARITY input of of pin A of P3. Connect pin A of J3 to BCD GROUND, pin Z of J3, if a positive going TRANSFER COMMAND is required.

Output Flexibility

Wire jumpers W1 through W7 provide the ability to use one or both of the PRINT COMMAND and VALID DATA LEVEL output buffers to provide independent logic polarity selection of the OFF-SCALE or SIGN output signals, or both. Most printers use either a negative or positive AC coupled level transition to initiate the printing cycle. It is therefore possible to wire the PRINT COMMAND one shot circuit output directly to pin E of P3 by removing jumpers W2 and W6. Either the negative going edge, or the delayed positive going edge will initiate a print cycle. In most cases, the small delay encountered when the printer uses the positive edge doesn't really matter. By removing the appropriate jumpers and installing wires it is possible to re-route the OFF-SCALE and SIGN output signals through the buffers and to a choice of output connector pins. If this is done, the polarity of each signal becomes independently programmable by the select lines available at pins J and H of J3.

One spare optical coupler circuit is available on the option board allowing another digital signal to be transmitted from the Model 7205 digital board, if a specialized application should require it. The extreme flexibility of the Model 7205 DIGITAL OUTPUT option board provides an easy interface with almost any data logging or measurement and control system which employs logic levels most commonly used since the introduction of integrated circuits. The Model 7205 DIGITAL OUTPUT option 05 is normally supplied with jumpers W1 through W7 installed. Please contact the factory if non-standard outputs are required. Field modifications of outputs by customers with adequate technical understanding can be easily made.

TABLE 3.4 BCD OUTPUT PIN FUNCTIONS

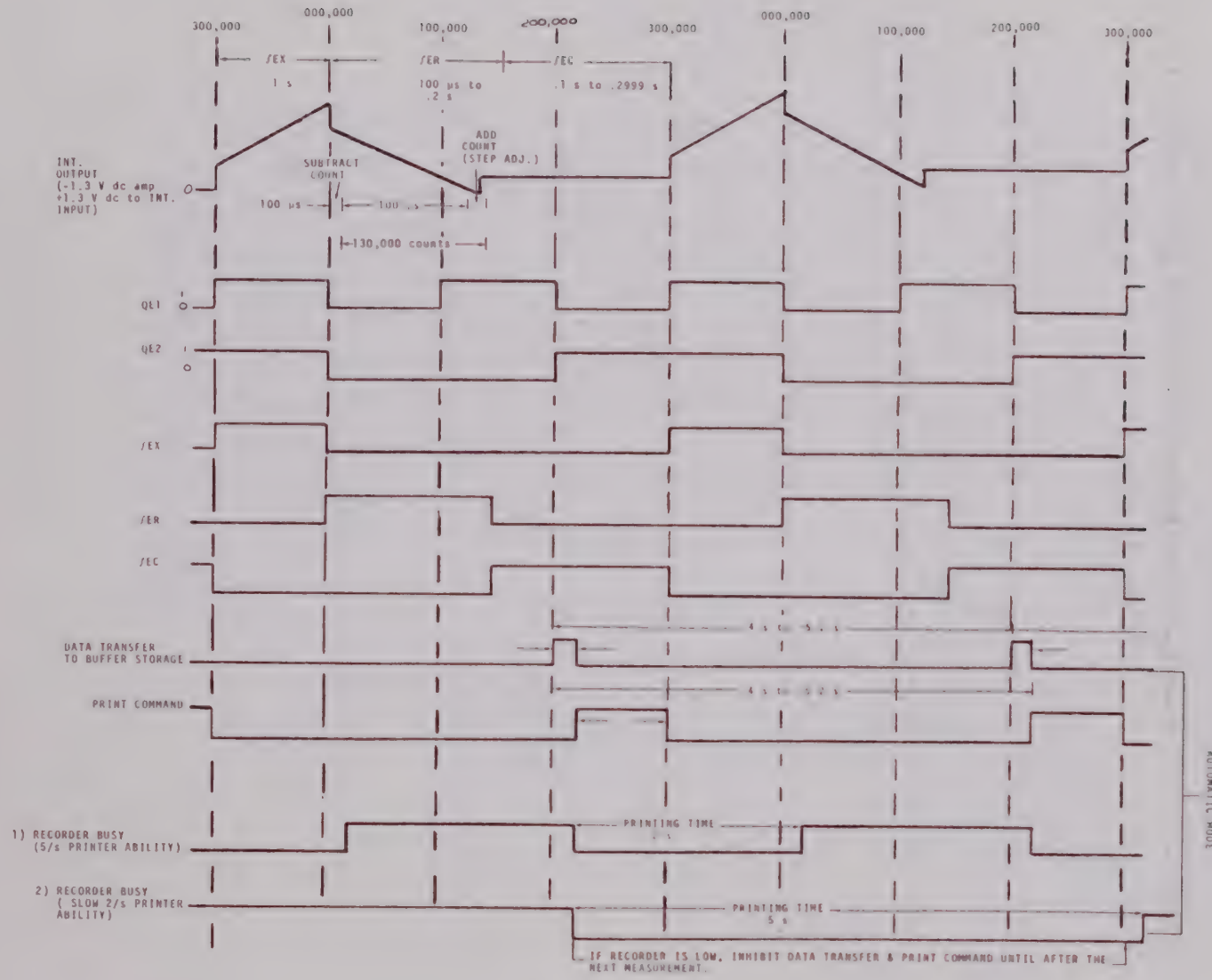
PIN	FUNCTION
1	1
2	2 — Function
3	4
	0 = NO FUNCTION SELECTED
	1 = V (dc) 4 = kΩ
	2 = AC mA 5 = kΩ 10 M
	3 = AC V 6 = mA (dc)
4	Sign Output
5	1
6	2 — Range
7	4
	0 = NO RANGE SELECTED
	1 = .1 RANGE 3 = 10 RANGE
	2 = 1 RANGE 4 = 100 RANGE
	5 = 1000 RANGE
8	Off-Scale Output
9	1
10	2
11	4 — 2nd Digit
12	8
13	1
14	2
15	4 — 4th Digit
16	8
17	1
18	2
19	4 — Over-Range Digit
20	8
21	Data Polarity Select
22	+5 V Ref.
A	Transfer Polarity
B	Transfer Command
C	Mode Selector Inhibit Polarity
D	Mode Select or Printer Inhibit
E	Print Command Pulse
F	Valid Data Level
H	Valid Data Polarity
J	Print Command Polarity
K	1
L	2
M	4 — Least significant Digit
N	8
P	1
R	2
S	4 — 3rd Digit
T	8

TABLE 3.4 BCD OUTPUT PIN FUNCTIONS (Cont'd)

PIN	FUNCTION
U	1
V	2
W	4
X	8
	(1, 2, 4, 8 — 5th Digit)
Y	Spare
Z	BCD Ground

TABLE 3.5 DELAY TIMES AFTER INPUT SWITCHED IN

	TRANSFER COMMAND	PRINT COMMAND
V, mA All Ranges	.5 s	0 to .4 s after Transfer Command
AC V, AC mA All Ranges	2.5 s	0 to .4 s after Transfer Command
kΩ .1,1,10,100	.5 s	0 to .4 s after Transfer Command
kΩ 1000	1.5 s	0 to .4 s after Transfer Command
kΩ 10 MΩ	1.5 to 10 s (.5 s + 1 s per MΩ)	0 to .4 s after Transfer Command



TIMING DIAGRAM FIGURE 3.1

CHAPTER 4
MAINTENANCE

4.1 INTRODUCTION

It is recommended that the Model 7205 DMM be calibrated every 90 days to maintain its specified accuracy. This section will define a procedure to calibrate a functioning Model 7205 to within its listed specifications. The entire calibration procedure should be performed even though only one of the functions may be out of specification. The only exception is if the unit meets specifications on all functions except on high frequency AC. These adjustments may be made with the covers on and through access holes in the bottom of the unit.

All adjustments should be made at standard conditions of +23 ±1°C with a maximum of 70% relative humidity if complete conformance to all published specifications is required. Calibration in uncontrolled environments will result in some accuracy degradation partially contributed by the calibration standards used.

4.2 CALIBRATION EQUIPMENT

Table 4.1, Recommended Calibration Equipment, lists standards with sufficient accuracy to perform both the operational check and the calibration of the Model 7205 DMM. A test fixture is needed for DC calibration, if maximum accuracy is to be achieved. A Kelvin-Varley voltage divider may be used with the DC voltage standard for this purpose.

TABLE 4.1 RECOMMENDED CALIBRATION EQUIPMENT

DC VOLTAGE STANDARD	Fluke Model 332D
KELVIN-VARLEY VOLTAGE DIVIDER	Fluke Model 720A
DC CURRENT STANDARD	Fluke Model 382A
AC VOLTAGE STANDARD	Hewlett-Packard Model 745A AC Calibrator Model 746A High Voltage Amplifier
RESISTANCE STANDARD	Electro-Scientific Industries Model 1063B Volt-Ohm Box

4.3 CALIBRATION

CAUTION: Avoid accidental adjustment of temperature compensation pots.

DC V

1. Calibration should be performed with all shields in place.

2. Remove the rear corner die cast trim pieces to allow bottom cover removal. Leave the bottom cover in place. Install a gold plated brass or copper shorting plug and select the .1 VDC range. Apply power and allow a minimum of two hours after turn on for the internal temperature to stabilize. The instrument should be in a horizontal position with top cover up to ensure normal internal temperature rises. The final calibration area should be temperature controlled at standard conditions of +23 ±1°C if complete performance to published specifications is to be expected.

3. Zero the .1 VDC range to ±3 counts. Select the .1 VAC range and adjust the front panel AC NULL adjustment. The null should be 3 to 6 counts. If not, readjustment of the DIODE BIAS pot R84 is required. Remove the bottom cover and adjust R84, for a 4 count null. Replace the bottom cover and allow an additional 30 minutes stabilization time before proceeding with the calibration procedure.

4. Select the .1 VDC range. Connect a Fluke 332D or equivalent voltage standard by a shielded cable to INPUT HI and LO. All cables and connectors used should be gold plated copper or brass for low thermal connections. The standard should also be equipped with an accessory box containing switching provisions for polarity reversal, shorting INPUT HI and LO, and a stable precision wirewound 1000 to 1 voltage divider which may be switched in or out.

   The jacks, binding posts, and switches used on the switching and divider box should be low thermal gold plated brass or copper.

5. Short INPUT HI and LO by placing the accessory box switch to the shorting position. Allow any thermals from switching to stabilize and readjust the .1 VDC range zero if necessary.

6. Select the 10 VDC range. The reading should be ±00.0000. If not, turn the instrument on its top cover on a padded scratch proof surface. Slip the bottom cover back far enough for access to the INT ZERO ADJ pot R79. Carefully adjust R79 until the readout is all zeros and the polarity switches back and forth between + and -. Slide the bottom cover back into the closed position.

7. Apply -.90 millivolts DC from the 1000 to 1 divider output on the voltage standard. Increase the input voltage in step increments of -.01 millivolts until the point where the readout switches back and forth between -9 and -10 digits. The optimum input for this to occur is at -.97 millivolts input. Remember the input required, and switch the input voltage to +.90 milli-

volts. Increase the input voltage in .01 millivolt increments until the readout switches back and forth between 9 and 10 digits. Note this input voltage.

It should ideally be +.97 millivolts. If necessary readjust the INT ZERO pot R79 until the decision point between 9 and 10 digits is within ±.02 millivolts for either polarity of input. If the decision point for switching between 9 and 10 digits is not at ±.97 millivolts ±.02 millivolts, set the input voltage to ±.97 millivolts and adjust the STEP ADJ pot R111 until the readout switches back and forth between 9 and 10 digits. The ZERO DET balance pot (R146) may be used as a fine vernier adjust after the INT ZERO has been set as close as possible to achieve the last fraction of a digit balance.

8. Set the input voltage to zero by setting all range switches on the standard to zero. Apply a positive input in increments of .01 millivolt until the least significant digit switches back and forth between 0 and 1. This should ideally occur at +.06 ±.03 millivolts input. Reverse polarity and apply a negative input in increments of .01 millivolt. Determine the input required for the least significant digit to switch between 0 and 1. Again, the ideal switching point between 0 and 1 is at -.06 ±.03 millivolts input. If the low end linearity is such that the instrument does not read ±00.0000 with the input shorted, it can be improved by adjusting the ZERO DET BALANCE pot R146. The normal setting of R146 is approximately at the center of its mechanical rotation. If low end linearity improvement is needed, adjust R146 close to one extreme or the other, and repeat the zero balancing and stop adjustment procedure. Finding the best setting for R146 is a trial and error procedure which is rather time consuming. It should only be adjusted if absolutely necessary.

9. Recheck the .1 VDC range zero with inputs shorted and readjust the front panel DC ZERO if the zero offset is more than ±3 counts.

10. Select the 1 VDC range and apply -1.00000 VDC from the voltage standard. Adjust the + REF ADJ pot R95 for a readout of -1.00000 VDC ±1 count.

11. Reverse the input voltage polarity and apply +1.00000 VDC. Adjust the - REF ADJ pot R103 for a readout of +1.00000 VDC ±1 count.

12. Apply +.10000 VDC and read +.10000 VDC ±2 counts. Apply +.01000 VDC and read +.01000 VDC ±2 counts. (Linearity check.)

13. Apply -.10000 VDC and read -.10000 VDC ±2 counts. Apply -.01000 VDC and read -.01000 VDC ±2 counts. (Linearity check.)

14. Select the 10 VDC range and apply -10.0000 VDC from the standard. Adjust the 10 VDC ADJ pot R57 for a readout of -10.0000 VDC ±1 count. Apply +10.0000 VDC and read +10.0000 VDC ±2 counts. If not, readjust R57 to split the error between the negative and positive inputs. The final reading for either polarity should be 10.0000 VDC ±2 counts. Apply ±13.1000 VDC and read ±13.1000 VDC ±2 counts. The readout will flash since 30% over-range has been exceeded, but the readings will be valid.

RESISTANCE

15. Disconnect the voltage standard and connect a precision resistance standard by means of a well shielded cable to INPUT HI and LO. Set the standard at zero resistance. Select the .1 VDC range and observe that the thermal voltages are stabilized. Retouch the front panel DC ZERO if necessary. (Note: The cable insulation resistance should exceed 10" ohms.)

16. Select the .1 KΩ range and adjust the front panel Ω LEAD COMP adjustment pot R104 to null out the test cable resistance.

17. Select the 100 KΩ range, set the standard to 100.000 KΩ, and adjust the 100 KΩ ADJ pot R90 for a readout of 100.000 KΩ ±1 count.

18. Select the 1 KΩ range, set the standard to 1.00000 KΩ, and adjust the 1 kV DC ADJ pot R50 for a readout of 1.00000 KΩ ±1 count.

19. Repeat steps 17 and 18.

20. Select the 1000 KΩ range, set the standard to 1000.00 KΩ, and adjust the 100 VDC ADJ pot R34 for a readout of 1000.00 KΩ ±1 count.

21. Disconnect the resistance standard. Re-connect the DC voltage standard. Select the 100 VDC range and apply -100.000 VDC. Read -100.000 VDC ±2 counts. If not, readjust the 100 VDC ADJ pot R34 to obtain a readout of -100.000 VDC ±1 count. Reverse the voltage input polarity and apply +100.000 VDC. Read +100.000 VDC ±2 counts. If not, split the error between the positive and negative inputs. The final reading for either polarity should be ±100.000 VDC ±2 counts.

22. Select the 1000 VDC range. Apply -1000.00 VDC and read -1000.00 VDC ±5 counts. If not readjust the 1 KVDC ADJ pot R39 for a readout of -1000.00 VDC ±1 count. Reverse the voltage input polarity and read +1000.00 VDC ±5 counts. If not, split the error between the positive and negative inputs. The final reading for either polarity should be ±1000.00 VDC ±5 counts.

23. Disconnect the voltage standard and reconnect the resistance standard. Select the .1 KΩ range and readjust the front panel Ω LEAD COMP. pot R104 if necessary to obtain less than 5 digits readout with the standard set at all zeros. Set the standard to .100000 K , and adjust the 100 Ω ADJ R87 for a readout of .100000 KΩ ±5 digits.

24. Recheck the rest of the resistance ranges for final calibration. Do not readjust without following the procedure.

Range	Reading
1 KΩ	1.00000 KΩ ±12 digits
10 KΩ	10.0000 KΩ ±12 digits
100 KΩ	100.000 KΩ ±12 digits
1000 KΩ	1000.00 KΩ ±18 digits
10 MΩ	10.0000 MΩ ±36 digits

DC mA

25. Disconnect the resistance standard, select the 1000 mA DC range, and apply -1000.00 mA DC between INPUT HI and LO. Read -1000.00 mA DC ±150 counts. Reverse the input current polarity and read +1000.00 mA DC ±150 counts. Reduce the input current to zero.

26. Select the 100 mA DC range, and apply -100.000 mA DC. Read -100.000 mA DC ±150 counts. Reverse the input current polarity and read +100.000 mA DC ±150 counts. Reduce the input current to zero.

27. Select the 10 mA DC range and apply -10.0000 mA DC. Read -10.0000 mA DC ±120 counts. Reverse the input current polarity and read +10.0000 mA DC ±120 counts. Reduce the input current to zero.

28. Select the 1 mA DC range and apply -1.00000 mA DC. Read -1.00000 mA DC ±120 counts. Reverse the input current polarity and read +1.00000 mA DC ±120 counts. Reduce input current to zero.

29. Select the .1 mA DC range and apply -.100000 mA DC. Read -.100000 mA DC ±120 counts. Reverse the input current polarity and read +.100000 mA DC ±120 counts. Reduce input current to zero. Disconnect the DC current standard.

AC V

30. Select the .1 VAC range and check that the null with inputs shorted is still 3 to 6 counts. If not, readjust the front panel AC NULL pot.

31. Select the 1 VAC range and apply 1.0000 VAC RMS at 200 Hz. Input LO and GUARD must be connected by a shorting link for all AC measurements. Slide the bottom cover back enough to give access to the 1 VAC ADJ pot R6 and adjust for a readout of 1.0003 VAC ±1 count. Slide the bottom cover forward into place. Apply 1.0000 VAC RMS at 100 kHz. Adjust the 1 VAC range frequency compensation trimmer capacitor C8 for a readout of 1.0003 VAC ±1 count. Apply .10000 VAC at 100 kHz and read 0.1000 VAC ±4 counts. Select the .1 VAC range and read .10000 VAC ±40 counts. Apply .01000 VAC at 100 kHz and read .01000 VAC ±25 counts.

32. Select the 10 VAC range. Apply 10.000 VAC RMS at 200 Hz. Read 10.000 VAC ±20 counts. Apply 10.000 VAC RMS at 100 kHz. Adjust 10 VAC compensation capacitor C6 for a readout of 10.000 VAC ±2 counts. Apply 10.000 VAC RMS at 20 kHz, read 10.000 VAC ±20 counts.

33. Select the 100 VAC range. Apply 100.00 VAC RMS at 200 Hz. Read 100.00 VAC ±20 counts. Apply 100.00 VAC RMS at 35 kHz. Adjust compensation capacitor C4 for a reading of 100.00 VAC ±2 counts. Apply 100.00 VAC RMS at 60 kHz. Read 100.00 VAC ±65 counts. Apply 100.00 VAC RMS at 20 kHz. Read 100.00 VAC ±20 counts.

34. Select the 1000 VAC range. Apply 500.0 VAC RMS at 200 Hz. Read 500.0 VAC ±10 counts. Apply 500.0 VAC RMS at 10 kHz. Adjust the 1000 VAC range frequency compensating capacitor C2 for a reading of 500.0 VAC ±2 counts. Apply 500.0 VAC RMS at 7 kHz. Read 500.0 VAC ±17 counts. Apply 500.0 VAC RMS at 15 kHz. Read 500.0 VAC ±50 counts.

35. Switch the High Voltage Standard to standby and disconnect the input.

36. Select the .1 AC mA range. Apply .10000 VAC at 200 Hz. Read approximately .10000 AC mA. This test does not check calibration accuracy, but only insures that no shunt protection fuses are blown and that the instrument will function in the AC mA mode. The previous DC current calibration check has verified the shunt resistor accuracies.

37. Disconnect the AC standard, short INPUT HI to LO. Select the .1 VDC range and check the zero reading. Readjust the front panel DC ZERO pot if the readout is more than ±5 digits. Select the 10 VDC range and check that the zero is within ±1 digit. Select the 1000 VDC range. Disconnect the INPUT HI and LO shorting jumper.

38. Calibration complete.

TABLE 4.2 MODEL 7205 AT +23°C ±5°C CALIBRATION TEST
FOR INSTRUMENTS CALIBRATED AT STANDARD +23°C ±1°C

Range and Function	Spec. 90 Day Spec. 23°C ±5°C	Input	Spec. 90 Day ± Dev.
VDC			
.1 VDC			
Input derived from 100/1 Kelvin-Varley ratio divider or equiv.	±.014% Rdg. ±.016% F.S.	±.100000 VDC	±30
		±.010000 VDC	±17
		±.000000 VDC	±16
1 VDC			
Input derived from 10/1 Kelvin-Varley ratio divider or equiv.	±.01% Rdg. ±.003% F.S.	±1.00000 VDC	±13
		±0.10000 VDC	±4
		±0.00000 VDC	±3
10 VDC	±.01% Rdg. ±.003% F.S.	±13.0000 VDC	±16
		±10.0000 VDC	±13
		±01.0000 VDC	±4
		±00.0000 VDC	±3
100 VDC	±.01% Rdg. ±.003% F.S.	±100.000 VDC	±13
		±010.000 VDC	±4
		±000.000 VDC	±3
1000 VDC	±.01% Rdg. ±.003% F.S. Add .05 ppm/volt	±1000.00 VDC	±18
		±0100.00 VDC	±4
		±0000.00 VDC	±3

TABLE 4.2 MODEL 7205 AT +23°C ±5°C CALIBRATION TEST FOR INSTRUMENTS CALIBRATED AT STANDARD +23°C ±1°C (Cont'd)

Range and Function	Data Sheet 90 Day Spec. 23°C ±5°C	Input	Data Sheet ± Dev.
mADC			
.1 mADC	±.12% Rdg. ±.02% F.S.	±.100000 mAdc	±140
		±.010000 mAdc	±32
		±.000000 mAdc	±20
1 mADC	±.12% Rdg. ±.02% F.S.	±1.00000 mAdc	±140
		±0.10000 mAdc	±32
		±0.00000 mAdc	±20
10 mADC	±.12% Rdg. ±.02% F.S.	±10.0000 mAdc	±140
		±01.0000 mAdc	±32
		±00.0000 mAdc	±20
100 mADC	±.15% Rdg. ±.02% F.S.	±100.000 mAdc	±170
		±010.000 mAdc	±35
		±000.000 mAdc	±20
1000 mADC	±.15% Rdg. ±.02% F.S.	±1000.00 mAdc	±170
		±0100.00 mAdc	±35
		±0000.00 mAdc	±20

TABLE 4.2 MODEL 7205 AT +23°C ±5°C CALIBRATION TEST FOR INSTRUMENTS CALIBRATED AT STANDARD +23°C ±1°C (Cont'd)

Range and Function	Data Sheet 90 Day Spec. 23°C ±5°C	Freq.	Input	Data Sheet ± Dev.
VAC				
.1 VAC	±.4% Rdg. ±.15% F.S.	20 Hz	.10000 VAC .01000 VAC .00100 VAC	±55 ±19 ±15
	±.1% Rdg. ±.15% F.S.	50 Hz	.10000 VAC .01000 VAC .00100 VAC	±25 ±16 ±15
		1 kHz	.10000 VAC .01000 VAC .00100 VAC	±25 ±16 ±15
		40 kHz	.10000 VAC .01000 VAC .00100 VAC	±25 ±16 ±15
	±.1% Rdg. ±.25% F.S.	60 kHz	.10000 VAC .01000 VAC .00100 VAC	±35 ±26 ±25
	±.2% Rdg. ±.35% F.S.	100 kHz	.10000 VAC .01000 VAC .00100 VAC	±45 ±36 ±35

TABLE 4.2 MODEL 7205 AT +23°C ±5°C CALIBRATION TEST FOR INSTRUMENTS CALIBRATED AT STANDARD +23°C ±1°C (Cont'd)

Range and Function	Data Sheet 90 Day Spec. 23°C ±5°C	Freq.	Input	Data Sheet ± Dev.
VAC (Cont'd)				
1 VAC	±.4% Rdg. ±.02% F.S.	20 Hz	1.0000 VAC 0.1000 VAC 0.0100 VAC	±42 ± 6 ± 2
	±.1% Rdg. ±.02% F.S.	50 Hz	1.0000 VAC 0.1000 VAC 0.0100 VAC	±12 ± 3 ± 2
		1 kHz	1.0000 VAC 0.1000 VAC 0.0100 VAC	±12 ± 3 ± 2
		40 kHz	1.0000 VAC 0.1000 VAC 0.0100 VAC	±12 ± 3 ± 2
	±.1% Rdg. ±.03% F.S.	60 kHz	1.0000 VAC 0.1000 VAC 0.0100 VAC	±13 ± 4 ± 3
	±.1% Rdg. ±.04% F.S.	100 kHz	1.3000 VAC 1.0000 VAC 0.1000 VAC 0.0100 VAC	±17 ±14 ± 5 ± 4

TABLE 4.2 MODEL 7205 AT +23°C ±5°C CALIBRATION TEST FOR INSTRUMENTS CALIBRATED AT STANDARD +23°C ±1°C (Cont'd)

Range and Function	Data Sheet 90 Day Spec. 23°C ±5°C	Freq.	Input	Data Sheet ± Dev.
VAC (Cont'd)				
10 VAC	±.5% Rdg. ±.02% F.S.	20 Hz	10.000 VAC 01.000 VAC 00.100 VAC	±52 ± 7 ± 2
	±.2% Rdg. ±.02% F.S.	50 Hz	10.000 VAC 01.000 VAC 00.100 VAC	±22 ± 4 ± 2
		1 kHz	10.000 VAC 01.000 VAC 00.100 VAC	±22 ± 4 ± 2
		40 kHz	10.000 VAC 01.000 VAC 00.100 VAC	±22 ± 4 ± 2
	±.2% Rdg. ±.03% F.S.	60 kHz	10.000 VAC 01.000 VAC 00.100 VAC	±23 ± 5 ± 3
	±.2% Rdg. ±.04% F.S.	100 kHz	13.000 VAC 10.000 VAC 01.000 VAC 00.100 VAC	±30 ±24 ± 6 ± 4

TABLE 4.2 MODEL 7205 AT +23°C ±5°C CALIBRATION TEST FOR INSTRUMENTS CALIBRATED AT STANDARD +23°C ±1°C (Cont'd)

Range and Function	Data Sheet 90 Day Spec. 23°C ±5°C	Freq.	Input	Data Sheet ± Dev.
VAC (Cont'd)				
100 VAC	±.5% Rdg. ±.02% F.S.	20 Hz	100.00 VAC	±52
			010.00 VAC	±7
			001.00 VAC	±2
	±.2% Rdg. ±.02% F.S.	50 Hz	100.00 VAC	±22
			010.00 VAC	±4
			001.00 VAC	±2
		20 kHz	100.00 VAC	±22
			010.00 VAC	±4
			001.00 VAC	±2
		40 kHz	130.00 VAC	±29
			100.00 VAC	±22
			010.00 VAC	±4
			001.00 VAC	±2
	±.7% Rdg. ±.03% F.S.	60 kHz	100.00 VAC	±73
			010.00 VAC	±10
			001.00 VAC	±3

TABLE 4.2 MODEL 7205 AT +23°C ±5°C CALIBRATION TEST FOR INSTRUMENTS CALIBRATED AT STANDARD +23°C ±1°C (Cont'd)

Range and Function	Data Sheet 90 Day Spec. 23°C ±5°C	Freq.	Input	Data Sheet ± Dev.
VAC (Cont'd)				
1000 VAC (500 volts max input)	±.5% Rdg. ±.02% F.S. Add .2 ppm/ (volt kHz)	20 Hz	0500.0 VAC	±28
			0100.0 VAC	±7
			0010.0 VAC	±2
	±.2% Rdg. ±.02% F.S. Add .2 ppm/ (volt kHz)	50 Hz	0500.0 VAC	±13
			0100.0 VAC	±4
			0010.0 VAC	±2
		2 kHz	0500.0 VAC	±14
			0100.0 VAC	±4
			0010.0 VAC	±2
		7 kHz	0500.0 VAC	±19
			0100.0 VAC	±5
			0010.0 VAC	±2
		10 kHz	0500.0 VAC	±22
			0100.0 VAC	±5
			0010.0 VAC	±2
	±.7% Rdg. ±.03% F.S. Add .2 ppm/ (volt kHz)	15 kHz	0500.0 VAC	±53
			0100.0 VAC	±13
			0010.0 VAC	±3

TABLE 4.2 MODEL 7205 AT +23°C ±5°C CALIBRATION TEST FOR INSTRUMENTS CALIBRATED AT STANDARD +23°C ±1°C (Cont'd)

Range and Function	Data Sheet 90 Day Spec. 23°C ±5°C	Input	Data Sheet ± Dev.
kΩ			
.1 kΩ	±0.02% Rdg. ±0.02% F.S. (±23° ±1°C)	.100000 kΩ	±40
1 kΩ	±0.015% Rdg. ±0.003% F.S.	1.00000 kΩ	±18
10 kΩ	±0.015% Rdg. ±0.003% F.S.	10.0000 kΩ	±18
100 kΩ	±0.015% Rdg. ±0.003% F.S.	100.000 kΩ	±18
1000 kΩ	±0.02% Rdg. ±0.003% F.S.	1000.00 kΩ	±23
10 MΩ	±0.05% Rdg. ±0.003% F.S.	10.0000 MΩ	±53

CHAPTER 5
PARTS LISTS

5.1 INTRODUCTION

This chapter contains a parts list for each assembly drawing in chapter 6. General parts lists column descriptions and a manufacturers code-to-name index is also provided in sections 5.2 and 5.3.

5.2 PARTS LIST COLUMN DESCRIPTION

Each column in the parts list provides specific information relating to the listed parts as follows:

1) DESIGNATOR: Ballooned item assemblies list parts in numerical order. Reference numbers applicable to assemblies are listed in alpha-numeric order.

2) COMPONENT NOMENCLATURE AND DESCRIPTION: Component names and specifications are provided in these columns and include: value, tolerance, wattage rating, working voltage, construction, etc.

3) MANUFACTURER'S CODE: H4-2 Federal Supply Code numbers are listed to identify component manufacturers. A Manufacturer's Index is provided in this chapter for cross-reference.

4) MANUFACTURER'S PART NUMBER: True manufacturer part numbers are listed in this column.

5) SD STOCK NUMBER: The Systron-Donner stock number is listed in this column.

6) T/Q (Total Quantity): This quantity, appearing after an item entry, indicates the number of times the component is used in that assembly.

5.3 MANUFACTURER'S INDEX

TABLE 5.1 CODE-TO-NAME CROSS-REFERENCE

Code	Name	Address
01121	Allen-Bradley Co.	1201 S. 2nd St., Milwaukee, Wis. 53204
01295	Texas Instruments Inc.	13500 N. Central Expressway Dallas, Texas 75231
03508	General Electric Co. Semiconductor Prod. Div.	Electronics Park, Syracuse, New York 13201

TABLE 5.1 CODE-TO-NAME CROSS-REFERENCE (Cont'd)

Code	Name	Address
03877	Transitron Electronic Corp.	168-186 Albion St., Wakefield, Mass. 01880
03888	Pyrofilm Corp.	60 S. Jefferson Road, Whippany, New Jersey 07981
04713	Motorola Semiconductor Products Inc.	5005 E. McDowell Rd., Phoenix, Arizona 85008
06383	Panduit Corp	17301 Ridgeland, Tinley Park, Ill. 60477
06540	Amatom Electronic Hardware Div. of Mite Corp.	81 Rockdale Ave., New Rochelle, New York 10806
07263	Fairchild Camer & Inst Corp., Semiconductor Div.	313 Frontage Rd., Mountain View, Calif. 94040
07933	Raytheon Co. Semiconductor Div. HQ.	350 Ellis St., Mountain View, Calif. 94040
12406	Elpac Inc	18651 Von Karman Ave., Irvine, Calif. 92664
13103	Thermalloy Co.	8717 Diplomacy Row, Dallas, Texas 75247
13715	Fairchild Camera & Inst. Corp., Diode Plant	300 Redwood Hwy., San Rafael, Calif. 94903
15818	Teledyne Inc. Semiconductor Div.	P.O. Box 1030, Mountain View, Calif. 94042
15915	Tepro of Florida Inc.	327 Patricia Ave., DuneDin, Florida 33528
16512	Fabri-Tek Inc. National Connector Div	9210 Science Center Ave., New Hope Minn. 55428
18612	Vishay Resistor Prod. Div. Vishay Intertechnology Inc.	68 Lincoln Hwy, Malvern, Pa. 19355
19701	Electra/Midland Corp.	P.O. Box 760, Mineral Wells, Texas 76067
20932	Electro Materials Div.	11620 Sorrento Valley Rd., San Diego, Calif. 92121
22229	Solitron Devices Inc.	8808 Balboa Ave., San Diego, Calif. 92123
27014	National Semiconductor Corp.	2950 San Ysidro Way, Santa Clara Calif. 95051

TABLE 5.1 CODE-TO-NAME CROSS-REFERENCE (Cont'd)

Code	Name	Address
27556	IMB Electronic Prod. Inc.	15401-E Carmenita Rd., Santa Fe, Springs, Calif. 90670
28480	Hewlett-Packard Co.	1501 Page Mill Rd., Palo Alto, Calif. 94304
32159	West-Cap Arizona	2201 E. Elvira Road, Tucson, Arizona 85706
32293	Intersil Inc.	10900 N. Tantan Ave., Cupertino, Calif. 95014
52542	Systron-Donner Corp	10 Systron Dr., Concord, Calif. 94518
56289	Sprague Electronic Co.	North Adams, Mass. 01247
71279	Cambridge Thermonic Corp.	445 Concord Ave., Cambridge, Mass. 02138
71785	Cinch Mfg. Co. & Howard B. Jones Div.	1026 S. Homan Ave., Chicago, Ill. 60624
72136	Electro Motive Mfg. Co. Inc.	South Park & John Sts., Willimantic Conn. 06226
72982	Erie Technological Prod. Inc.	644 W. 12th St., Erie, Pa. 16512
73138	Beckman Instruments Helipot Div.	2500 Harbor Blvd., Fullerton, Calif. 92634
73899	JFD Electronics Corp	15th at 62nd St., Brooklyn, New York 11219
75042	TRW Electronic Components IRC.	401 N. Broad St., Philadelphia Pa. 19108
75915	Littlefuse Inc.	800 E. Northwest Hwy., Des Plaines, Ill. 60016
79963	Zierick Mfg. Co.	Radio Circle, Mt. Kisco, New York 10549
80294	Bourns Inc.	1200 Columbia Ave., Riverside, Calif. 92507
83330	Smith Herman H Inc.	812 Snediker Ave., Brooklyn, New York 11207
88245	Litton Precision Prod	13536 Saticoy St., Van Nuys, Calif. 91409
90201	Mallory Capacitor Co.	3029 E. Washingron St., P.O.Box 372, Indianapolis, In. 46206

TABLE 5.1 CODE-TO-NAME CROSS-REFERENCE (Cont'd)

Code	Name	Address
91418	Radio Materials Co.	4242 W. Bryn Mawr, Chicago, Ill. 60646
91506	Augat Inc.	33 Perry Ave., Attleboro, Mass. 02703
91637	Dale Electronics Inc.	P.O. Box 609, Columbus, Neb. 68601
98921	Q & M Mfg. Co.	8203 Market St. Road, Houston, Texas 77029
99392	STM	2904 Chapman St., Oakland, Calif. 94601

5.4 PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION: A1, READOUT P.C. ASSEMBLY #03757201

(1) DESIGNATOR ITEM	(1) DESIGNATOR REF	(2) COMPONENT NOMENCLATURE AND DESCRIPTION	(3) MFR'S CODE	(4) MANUFACTURER'S PART NUMBER	(5) SD STOCK NO.	(6) T/Q
		Readout P.C. Assembly	52542	03757201	03757201	1
		Readout P.C. Schematic	52542	7-03757301	7-03757301	1
	J1	Connector, 30 pin	16512	200264	101277	1
	XV1	Connector, CS352	91637	MFF-1/8 T1	102445	2
	XV2	Connector, CS353	91637	MFF-1/8 T1	102446	1
		Bracket, Chassis, 4-40	88245	1591-B-11	101090	2

EQUIPMENT/ASSEMBLY DESIGNATION A2, DIGITAL P.C. ASSEMBLY # 03757301

(1) DESIGNATOR ITEM	REF	(2) COMPONENT NOMENCLATURE AND DESCRIPTION	(3) MFR'S CODE	(4) MANUFACTURER'S PART NUMBER	(5) SD STOCK NO.	(6) T/Q
		Digital P.C. Board Assembly	52542	03757301	03757301	1
		Digital P.C. Schematic	52542	7-03757301	7-03757301	1
	C1	Capacitor, .1 µF, 100 V, Mylar	32159	4M1104J	100265	1
	C2	Capacitor, .05 µF, 50 V, Disc	56289	TGS50	100134	1
	C3	Capacitor, .05 µF, 50 V, Disc	56289	TGS50	100134	1
	C4	Capacitor, .05 µF, 50 V, Disc	56289	TGS50	100134	1
	C5	Capacitor, 4.7 µF, 10 V, Tant	56289	150D475X9010A2	100205	1
	C6	Capacitor, 39 µF, 10 V, Tant	56289	150DX396X9010B2	100183	1
	C7	Capacitor, .05 µF, 50 V, Disc	56289	TGS50	100134	1
	C8	Capacitor, .001 µF, 1 kV, Disc	91418	TYPE B	100076	1
	C9	Capacitor, 2000 pF, 100 V	72982	8121-100W5R222K	102623	1
	C10	Capacitor, .01 µF, 200 V, Mylar	32159	4M103M	102602	1
	C11	Capacitor, 330 pF, 500 V	72136	DM15FD331J0	10027601	1
	C12	Capacitor, 330 pF, 500 V	72136	DM15FD331J0	10027601	1
	C13	Capacitor, 4700 pF, 200 V, Mylar	27556	IMB2P2C472J	102964	1
	C14	Capacitor, .05 µF, 50 V, Disc	56289	TGS50	100134	1
	C15	Capacitor, 330 pF, 500 V	72136	DM15FD331J0	10027601	1
	C16	Capacitor, 330 pF, 500 V	72136	DM15FD331J0	10027601	1
	C17	Capacitor, .05 µF, 50 V, Disc	56289	TGS50	100134	1
	C18	Capacitor, 330 pF, 500 V	72136	DM15FD331J0	10027601	1
	C19	Capacitor, 1000 pF, 100 V	72982	8121-100W5R222K	102620	1
	C20	Not Used				
	C21	Capacitor, .01 µF, 200 V, Mylar	32159	4M103M	102602	1
	C22	Capacitor, 330 pF, 500 V	72136	DM15FD331J0	10027601	1
	C23	Capacitor, 560 pF, 300 V	72136	DM15FC561J0	10022201	1
	C24	Capacitor, 689 pF, 300 V	72136	DM15FC681J0	10027501	1
	C25	Capacitor, 1000 pF, 100 V	72982	8212-100W5R222K	102620	1
	C26	Capacitor, .05 µF, 50 V, Disc	56289	TGS50	100134	1
	C27	Capacitor, .05 µF, 50 V, Disc	56289	TGS50	100134	1
	C28	Capacitor, 330 pF, 500 V	72136	DM15FD331J0	10027601	1
	C29	Capacitor, 330 pF, 500 V	72136	DM15FD331J0	10027601	1
	CR1	Diode, 1N4151	03508	1N4151	100385	1
	CR2	Diode, 1N4151	03508	1N4151	100385	1
	Q1	Semiconductor Device, Transistor: Silicon, NPN	04713	MPS-A42	101421	1
	Q2	Semiconductor Device, Transistor: Silicon, NPN	04713	MPS-A42	101421	1
	Q3	Semiconductor Device, Transistor: Silicon, NPN	04713	MPS-A42	101421	1
	Q4	Semiconductor Device, Transistor: Silicon, NPN	04713	MPS-A42	101421	1
	Q5	Semiconductor Device, Transistor: Silicon, NPN	04713	MPS-A42	101421	1
	Q6	Semiconductor Device, Transistor: Silicon, NPN	07263	2N5831	102676	1
	Q7	Not Used				
	Q8	Not Used				
	Q9	Not Used				
	Q10	Semiconductor Device, Transistor: Silicon, NPN	07263	2N5831	102676	1
	Q11	Semiconductor Device, Transistor: Silicon, PNP	07263	PN4889-18	101422	1

EQUIPMENT/ASSEMBLY DESIGNATION: A2, DIGITAL P.C. ASSEMBLY #03757301 (Cont'd)

(1) DESIGNATOR ITEM	(1) DESIGNATOR REF	(2) COMPONENT NOMENCLATURE AND DESCRIPTION	(3) MFR'S CODE	(4) MANUFACTURER'S PART NUMBER	(5) SD STOCK NO.	(6) T/Q
	Q12	Semiconductor Device, Transistor: Silicon, PNP	07263	PN4889-18	101422	1
	Q13	Semiconductor Device, Transistor: Silicon, PNP	07263	PN4889-18	101422	1
	Q14	Semiconductor Device, Transistor: Silicon, PNP	07263	PN4889-18	101422	1
	Q15	Semiconductor Device, Transistor: Silicon, PNP	07263	PN4889-18	101422	1
	Q16	Semiconductor Device, Transistor: Silicon, NPN	07263	2N4275	102716	1
	Q17	Semiconductor Device, Transistor: Silicon, NPN	07263	2N5831	102676	1
	Q18	Semiconductor Device, Transistor: Silicon, NPN	07263	2N5831	102676	1
	Q19	Semiconductor Device, Transistor Silicon, NPN	07263	2N5831	102676	1
	R1	Resistor, Comp: 8.2 k 5%, 1/4 W	01121	CB8225	101595	1
	R2	Resistor, Comp: 33 k 5%, 1/4 W	01121	CB3335	101576	1
	R3	Resistor, Comp: 4.7 k 5%, 1/4 W	01121	CB4725	101598	1
	R4	Resistor, Comp: 10 k 5%, 1/4 W	01121	CB1035	101570	1
	R5	Resistor, Comp: 10 k 5%, 1/4 W	01121	CB1035	101570	1
	R6	Resistor, Comp: 4.7 k 5%, 1/4 W	01121	CB4725	101598	1
	R7	Resistor, Comp: 33 k 5%, 1/4 W	01121	CB3335	101576	1
	R8	Resistor, Comp: 4.7 k 5%, 1/4 W	01121	CB4725	101598	1
	R9	Resistor, Comp: 100 k 5%, 1/4 W	01121	CB1045	101558	1
	R10	Resistor, Comp: 47 k 5%, 1/4 W	01121	CB4735	101574	1
	R11	Resistor, Comp: 10 M 5%, 1/4 W	01121	CB1065	101564	1
	R12	Resistor, Comp: 47 k 5%, 1/4 W	01121	CB4735	101574	1
	R13	Resistor, Comp: 100 k 5%, 1/4 W	01121	CB1045	101558	1
	R14	Resistor, Comp: 47 k 5%, 1/4 W	01121	CB4735	101574	1
	R15	Resistor, Comp: 100 k 5%, 1/4 W	01121	CB1045	101558	1
	R16	Resistor, Comp: 47 k 5%, 1/4 W	01121	CB4735	101574	1
	R17	Resistor, Comp: 100 k 5%, 1/4 W	01121	CB1045	101558	1
	R18	Resistor, Comp: 10 M 5%, 1/4 W	01121	CB1065	101564	1
	R19	Resistor, Comp: 47 k 5%, 1/4 W	01121	CB4735	101574	1
	R20	Resistor, Comp: 100 k 5%, 1/4 W	01121	CB1045	101558	1
	R21	Resistor, Comp: 10 M 5%, 1/4 W	01121	CB1065	101564	1
	R22	Resistor, Comp: 15 k 5%, 1/4 W	01121	CB1535	101552	1
	R23	Resistor, Comp: 15 k 5%, 1/4 W	01121	CB1535	101552	1
	R24	Resistor, Comp: 15 k 5%, 1/4 W	01121	CB1535	101552	1
	R25	Resistor, Comp: 15 k 5%, 1/4 W	01121	CB1535	101552	1
	R26	Resistor, Comp: 15 k 5%, 1/4 W	01121	CB1535	101552	1
	R27	Resistor, Comp: 15 k 5%, 1/4 W	01121	CB1525	101552	1
	R28	Resistor, Comp: 15 k 5%, 1/4 W	01121	CB1535	101552	1
	R29	Resistor, Comp: 10 k 5%, 1/4 W	01121	CB1035	101570	1
	R30	Resistor, Comp: 3 k 5%, 1/4 W	01121	CB3025	101548	1
	R31	Not Used				
	R32	Resistor, Comp: 10 k 5%, 1/4 W	01121	CB1035	101570	1
	R33	Resistor, Comp: 22 k 5%, 1/4 W	01121	CB2235	101572	1
	R34	Resistor, Comp: 33 k 5%, 1/4 W	01121	CB3335	101576	1
	R35	Resistor, Comp: 3 k 5%, 1/4 W	01121	CB3025	101548	1
	R36	Resistor, Comp: 15 k 5%, 1/4 W	01121	CB1535	101552	1

EQUIPMENT/ASSEMBLY DESIGNATION: A2, DIGITAL P.C. ASSEMBLY #03757301 (Cont'd)

(1) DESIGNATOR ITEM	(1) DESIGNATOR REF	(2) COMPONENT NOMENCLATURE AND DESCRIPTION	(3) MFR'S CODE	(4) MANUFACTURER'S PART NUMBER	(5) SD STOCK NO.	(6) T/Q
	R37	Resistor, Comp: 15 k 5%, 1/4 W	01121	CB1535	101552	1
	R38	Resistor, Comp: 15 k 5%, 1/4 W	01121	CB1535	101552	1
	R39	Resistor, Comp: 15 k 5%, 1/4 W	01121	CB1535	101552	1
	R40	Resistor, Comp: 15 k 5%, 1/4 W	01121	CB1535	101552	1
	R41	Resistor, Comp: 15 k 5%, 1/4 W	01121	CB1535	101552	1
	R42	Resistor, Comp: 15 k 5%, 1/4 W	01121	CB1535	101552	1
	R43	Resistor, Comp: 3 k 5%, 1/4 W	01121	CB3025	101548	1
	R44	Resistor, Comp: 10 k 5%, 1/4 W	01121	CB1035	101570	1
	R45	Resistor, Comp: 10 k 5%, 1/4 W	01121	CB1035	101570	1
	R46	Resistor, Comp: 10 k 5%, 1/4 W	01121	CB1035	101570	1
	R47	Resistor, Comp: 10 k 5%, 1/4 W	01121	CB1035	101570	1
	R48	Resistor, Comp: 1.5 k 5%, 1/4 W	01121	CB1525	101577	1
	R49	Resistor, Comp: 470 Ω 5%, 1/4 W	01121	CB4715	101625	1
	R50	Resistor, Comp: 47 k 5%, 1/4 W	01121	CB4735	101574	1
	R51	Resistor, Comp: 10 k 5%, 1/4 W	01121	CB1035	101570	1
	R52	Resistor, Comp: 10 k 5%, 1/4 W	01121	CB1035	101570	1
	R53	Resistor, Comp: 1.8 k 5%, 1/4 W	01121	CB1825	101602	1
	R54	Resistor, Comp: 3.3 k 5%, 1/4 W	01121	CB3325	101559	1
	R55	Resistor, Comp: 10 k 5%, 1/4 W	01121	CB1035	101570	1
	R56	Resistor, Comp: 10 k 5%, 1/4 W	01121	CB1035	101570	1
	R57	Resistor, Comp: 10 k 5%, 1/4 W	01121	CB1035	101570	1
	R58	Resistor, Comp: 10 k 5%, 1/4 W	01121	CB1035	101570	1
	R59	Resistor, Comp: 15 k 5%, 1/4 W	01121	CB1535	101552	1
	R60	Resistor, Comp: 2 k 5%, 1/4 W	01121	CB2025	101553	1
	R61	Resistor, Comp: 7.5 k 5%, 1/4 W	01121	CB7525	101596	1
	R62	Resistor, Comp: 1 k 5%, 1/4 W	01121	CB1025	101569	1
	R63	Resistor, Comp: 15 k 5%, 1/4 W	01121	CB1535	101552	1
	R64	Resistor, Comp: 10 k 5%, 1/4 W	01121	CB1035	101570	1
	R65	Resistor, Comp: 10 k 5%, 1/4 W	01121	CB1035	101570	1
	R66	Resistor, Comp: 2.2 k 5%, 1/4 W	01121	CB2225	101562	1
	R67	Resistor, Comp: 3.3 k 5%, 1/4 W	01121	CB3325	101559	1
	R68	Resistor, Comp: 3.3 k 5%, 1/4 W	01121	CB3325	101559	1
	R69	Resistor, Comp: 3.3 k 5%, 1/4 W	01121	CB3325	101559	1
	R70	Resistor, Comp: 3.3 k 5%, 1/4 W	01121	CB3325	101559	1
	R71	Resistor, Comp: 3.3 k 5%, 1/4 W	01121	CB3325	101559	1
	R72	Resistor, Comp: 10 k 5%, 1/4 W	01121	CB1035	101570	1
	R73	Resistor, Comp: 10 k 5%, 1/4 W	01121	CB1035	101570	1
	R74	Resistor, Comp: 2 k 5%, 1/4 W	01121	CB2025	101553	1
	R75	Resistor, Comp: 1.5 k 5%, 1/4 W	01121	CB4715	101625	1
	R76	Resistor, Comp: 3.3 k 5%, 1/4 W	01121	CB3325	101559	1
	R77	Resistor, Comp: 10 k 5%, 1/4 W	01121	CB1035	101570	1
	R78	Resistor, Comp: 10 k 5%, 1/4 W	01121	CB1035	101570	1
	R79	Resistor, Comp: 10 M 5%, 1/4 W	01121	CB1065	101564	1
	R80	Resistor, Comp: 10 M 5%, 1/4 W	01121	CB1065	101564	1
	U1	Integrated Circuit: Segment Dec/Driver	SPERRY	DD-700	045203	1
	U2	Integrated Circuit: Segment Dec/Driver	SPERRY	DD-700	045203	1
	U3	Integrated Circuit: 4-1/2 Digit, MOS	07263	A7R381419X	045215	1
	U4	Integrated Circuit: Hex Inverter, TTL	01295	SN74L04N	045204	1
	U5	Integrated Circuit: Quad 2-input NAND GATE, TTL	01295	SN74L03N	045217	1

EQUIPMENT/ASSEMBLY DESIGNATION: A2, DIGITAL P.C. ASSEMBLY #03757301 (Cont'd)

(1) DESIGNATOR ITEM	(1) DESIGNATOR REF	(2) COMPONENT NOMENCLATURE AND DESCRIPTION	(3) MFR'S CODE	(4) MANUFACTURER'S PART NUMBER	(5) SD STOCK NO.	(6) T/Q
	U6	Integrated Circuit: Hex Inverter, TTL	01295	SN7404N	025779	1
	U7	Integrated Circuit: Quad Latch, TTL	01295	SN74L75N	045201	
	U8	Integrated Circuit: Decade Counter, TTL	01295	SN7490N	025732	1
	U9	Integrated Circuit: Triple 3-input NAND GATE, TTL	01295	SN74L10N	045218	1
	U10	Integrated Circuit: Quad 2-input NAND GATE, TTL	01295	SN74L00N	025796	1
	U11	Integrated Circuit: Quad 2-input NAND GATE, TTL	27014	DM74L00N	045267	1
	U12	Integrated Circuit: Dual J-K flip-flop, TTL	01295	SN74L73N	045200	1
	U13	Integrated Circuit: Hex Inverter, TTL	27014	DM74L04N	045268	1
	U14	Integrated Circuit: Quad 2-input NAND GATE, TTL	01295	SN74L00N	025796	1
	U15	Integrated Circuit: Hex Inverter, TTL	01295	SN74L04N	045204	1
	U16	Integrated Circuit: Quad 2-input NAND GATE, TTL	01295	SN74L00N	025796	1
	U17	Integrated Circuit: Quad 2-input NOR GATE, TTL	01295	SN74L02N	025797	1
	U18	Integrated Circuit: Quad 2-input NAND GATE, TTL	01295	SN74L00N	045267	1
	U19	Integrated Circuit: Quad 2-input NOR GATE, TTL	01295	SN74L02N	025797	1
	U20	Integrated Circuit: Hex Inverter, TTL	27014	DM74L04N	045268	1
	U21	Integrated Circuit: Quad 2-input NAND GATE, TTL	27014	DM74L00N	045267	1
	U22	Integrated Circuit: Decade Counter, TTL	01295	SN74L90N	045202	1
	V1	Display: 7 segment, 1 character	SPERRY	SP-351	102402	1
	V2	Display: 7 segment, 2 character	SPERRY	SP-352	102403	1
	V3	Display: 7 segment, 3 character	SPERRY	SP-353	102404	1
	VR1	Diode: Zener	03877	1N752A	100376	1
	XY1	Clamp, Crystal	91506	800HP4	10244701	1
	Y1	Crystal, 1 MHz	- - -	CR18/U	102450	1
		Shield, Readout	52542	037608	037608	1
		Socket, Crystal	71785	102447	2JKC	1
		Connector, P.C. Pin-10 inch	00779	86090-4	100565	19
		Socket, Integrated Circuit 8-pin	22264	1938-4-B-8	102432	4
		Socket, Integrated Circuit 24-pin	71785	133-59-92-010	102449	1
		Bracket, Right Angle, 6-32	79963	176	100849	2
		Spacer, Swage, 4-40	06540	9627B-B-0440-3A	101116	2
		Spacer, Swage, 6-32	88245	1530 B 1/2	100532	4
		Spacer, Threaded, 4-40	06540	8155-B-0440-3	100018	2
		Screw, Flat Head Machine: 4-40 X 3/16	MIL	MS24693-C1	10072003	2
		Screw, Pan Head Machine: 4-40 X 1/4	MIL	MS51957-13	10062604	4
		Screw, Pan Head Machine: 4-40 X 7/16	MIL	MS51957-16	10062607	1
		Screw, Pan Head Machine: 6-32 X 5/16	MIL	MS51957-27	10063205	2
		Washer, #6 split-lock	MIL	MS35338-136	100712	2
		Washer, #6 flat	MIL	MS15795-805	100704	2
		Washer, #4 split-lock	MIL	MS35338-135	100711	9

EQUIPMENT/ASSEMBLY DESIGNATION A2, DIGITAL P.C. ASSEMBLY #03757301 (Cont'd)

(1) DESIGNATOR ITEM	(1) DESIGNATOR REF	(2) COMPONENT NOMENCLATURE AND DESCRIPTION	(3) MFR'S CODE	(4) MANUFACTURER'S PART NUMBER	(5) SD STOCK NO.	(6) T/Q
		Washer, #4 flat	MIL	MS15795-803	100703	8
		Tie, Cable: 0-3/4 nylon	06383	SSTIM	100753	1
		Nut, Hex: #4-40	MIL	NAS671C4	100622	1

EQUIPMENT/ASSEMBLY DESIGNATION: A3, ANALOG P.C. ASSEMBLY #03757491

(1) DESIGNATOR ITEM	(1) DESIGNATOR REF	(2) COMPONENT NOMENCLATURE AND DESCRIPTION	(3) MFR'S CODE	(4) MANUFACTURER'S PART NUMBER	(5) SD STOCK NO.	(6) T/Q
		Analog P.C. Board Assembly	52542	03757491	03757491	1
		Analog P.C. Schematic	52542	7-03757401	7-03757401	1
	C1	Capacitor: .1 µF, 1200 V	12406	ZD12A104	102593	1
	C2	Capacitor: .8-8.5 pF, 1000 V	73899	VC9GWY	100334	1
	C3	Capacitor: .022 µF 5%, 100 V	20932	5050E0100RD223J	100349	1
	C4	Capacitor: .8-8.5 pF, 1000 V	73899	VC9GWY	100334	1
	C5	Capacitor: 220 pF 5%, 100 V	20932	5030E0100RD222J	100348	1
	C6	Capacitor: .8-8.5 pF, 1000 V	73899	VC9GWY	100334	1
	C7	Capacitor: 180 pF 5%, 500 V	72136	DM15FD181J0	10023701	1
	C8	Capacitor: .8-8.5 pF, 1000 V	73899	VC9GWY	100334	1
	C9	Not Used				
	C10	Capacitor: 15 pF, 1 kV	56289	10TCC-Q15	100355	1
	C11	Not Used				
	C12	Capacitor: .01 µF +80-20%, 100 V	91418	TA110	100103	1
	C13	Capacitor: .01 µF +80-20%, 100 V	91418	TA110	100103	1
	C14	Not Used				
	C15	Capacitor: .01 µF +80-20%, 100 V	91418	TA110	100103	1
	C16	Capacitor: .1 µF 5%, 200 V	27556	GA2C104	100345	1
	C17	Capacitor: .1 µF 5%, 200 V	27556	GA2C104	100345	1
	C18	Capacitor: .047 µF 5%, 600 V	27556	GA2G473	100352	1
	C19	Capacitor: .047 µF 5%, 200 V	27556	GA2C473	100354	1
	C20	Capacitor: .05 µF +80-20%, 50 V	56289	TGS50	100134	1
	C21	Capacitor: .01 µF +80-20%, 100 V	91418	TA110	100103	1
	C22	Capacitor: 330 pF 5%, 500 V	72136	DM15FD331J0	10027601	1
	C23	Capacitor: .01 µF +80-20%, 100 V	91418	TA110	100103	1
	C24	Capacitor: 1 µF 5%, 200 V	27556	GA2C105	100347	1
	C25	Capacitor: 10 pF 5%, 500 V	72136	DM10CD100J0	100272	1
	C26	Capacitor: .01 µF +80-20%, 100 V	91418	TA110	100103	1
	C27	Not Used				
	C28	Capacitor: 33 pF 5%, 500 V	72136	DM15ED330J0	10017501	1
	C29	Capacitor: .68 µF 5%, 200 V	27556	GA2C684	100346	1
	C30	Capacitor: 100 pF 5%, 500 V	72136	DM15FD101J0	10017301	1
	C31	Capacitor: 100 pF 5%, 500 V	72136	DM15FD101J0	10071301	1
	C32	Capacitor: .01 µF +80-20%, 100 V	91418	TA110	100103	1
	C33	Not Used				
	C34	Capacitor: .01 µF +80-20%, 100 V	91418	TA110	100103	1
	C35	Capacitor: 10 pF 5%, 500 V	72136	DM10CD100J0	100272	1
	C36	Capacitor: 220 pF 5%, 500 V	72136	DM15FD221J0	10022001	1
	C37	Capacitor: 10 µF, 350 V	90201	TCW100N350G1F3P	100029	1
	C38	Capacitor: 100 µF, 50 V	99392	23C50TT13	100351	1
	C39	Capacitor: 100 µF, 50 V	99392	23C50TT13	100351	1
	C40	Capacitor: 220 pF 5%, 500 V	72136	DM15FD221J0	10022001	1
	C41	Capacitor: 200 pF 5%, 500 V	72136	DM15FD221J0	10022001	1
	C42	Capacitor: Trimmer, 9-35 pF	72982	538-006D9.0-35	100159	1
	C43	Capacitor: 12 pF 5%, 500 V	72136	DM15CD120J0	10024001	1
	C44	Not Used				
	C45	Capacitor: 7000 µF, 10 V	99392	23C10TT73	100350	1
	C46	Capacitor: .01 µF +80-20%, 100 V	91418	TA110	100103	1
	C47	Capacitor: .01 µF +80-20%, 100 V	91418	TA110	100103	1

EQUIPMENT/ASSEMBLY DESIGNATION A3, ANALOG P.C. ASSEMBLY #03757491 (Cont'd)

(1) DESIGNATOR ITEM	REF	(2) COMPONENT NOMENCLATURE AND DESCRIPTION	(3) MFR'S CODE	(4) MANUFACTURER'S PART NUMBER	(5) SD STOCK NO.	(6) T/Q
	C48	Capacitor: .01 µF +80-20%, 100 V	91418	TA110	100103	1
	C49	Capacitor: .01 µF +80-20%, 100 V	91418	TA110	100103	1
	C50	Capacitor: .05 µF +80-20%, 50 V	56289	TGS50	100134	1
	C51	Capacitor: .05 µF +80-20%, 50 V	56289	TGS50	100134	1
	C52	Capacitor: .01 µF 20%, 500 V	91418	TYPE SM	100075	1
	C53	Capacitor: 1.0 µF 10%, 35 V	56289	150D105X9035A2	100082	1
	C54	Capacitor: 1.0 µF 10%, 35 V	56289	150D105X9035A2	100082	1
	C55	Capacitor: 100 pF 5%, 500 V	72136	DM15FD101J0	10017301	1
	C56	Capacitor: 5 pF 10%, 500 V	72136	DM15CD050D0	100218	1
	C57	Capacitor: 10 pF 5%, 500 V	72136	DM10CD100J0	100272	1
	C58	Capacitor: 10 pF 5%, 500 V	72136	DM10CD100J0	100272	1
	C59	Capacitor: 10 pF 5%, 500 V	72136	DM10CD100J0	100272	1
	C60	Capacitor: .01 µF +80-20%, 100 V	91418	TA110	100103	1
	C61	Capacitor: .01 µF +80-20%, 100 V	91418	TA110	100103	1
	C62	Capacitor: .01 µF +80-20%, 100 V	91418	TA110	100103	1
	C63	Capacitor: .01 µF +80-20%, 100 V	91418	TA110	100103	1
	CR1	Diode, Signal: 70 V	28480	5082-2800	100442	1
	CR2	Diode, Signal: 70 V	28480	5082-2800	100442	1
	CR3	Diode, Signal: 70 V	28480	5082-2800	100442	1
	CR4	Diode, Signal: 70 V	28480	5082-2800	100442	1
	CR5	Diode, Rectifier: 600 V	04713	1N4005	100413	1
	CR6	Diode, Rectifier: 600 V	04713	1N4005	100413	1
	CR7	Diode, Signal: 50 V	03508	1N4151	100385	1
	CR8	Diode, Signal: 125 V	13715	FD-300	102703	1
	CR9	Diode, Signal: 125 V	13715	FD-300	102703	1
	CR10	Diode, Signal: 125 V	13715	FD-300	102703	1
	CR11	Diode, Signal: 125 V	13715	FD-300	102703	1
	CR12	Diode, Signal: 50 V	03508	1N4151	100385	1
	CR13	Diode, Signal: 50 V	03508	1N4151	100385	1
	CR14	Diode, Signal: 50 V	03508	1N4151	100385	1
	CR15	Diode, Signal: 50 V	03508	1N4151	100385	1
	CR16	Diode, Silicon PNP	07263	2N3640	101357	1
	CR17	Diode, Silicon PNP	07263	2N3640	101357	1
	CR18	Diode, Signal: 125 V	13715	FD-300	102703	1
	CR19	Diode, Signal: 50 V	03805	1N4151	100385	1
	CR20	Diode, Rectifier: 600 V	04713	1N4005	100413	1
	CR21	Diode, Rectifier: 600 V	04713	1N4005	100413	1
	CR22	Diode, Rectifier: 600 V	04713	1N4005	100413	1
	CR23	Diode, Rectifier: 600 V	04713	1N4005	100413	1
	CR24	Diode, Rectifier: 600 V	04713	1N4005	100413	1
	CR25	Diode, Rectifier: 600 V	04713	1N4005	100413	1
	CR26	Diode, Rectifier: 600 V	04713	1N4005	100413	1
	CR27	Diode, Rectifier: 600 V	04713	1N4005	100413	1
	CR28	Diode, Rectifier: 600 V	04713	1N4005	100413	1
	CR29	Diode, Rectifier: 600 V	04713	1N4005	100413	1
	CR30	Diode, Signal: 50 V	03508	1N4151	100385	1
	CR31	Diode, Rectifier: 600 V	04713	1N4005	100413	1
	CR32	Diode, Rectifier: 600 V	04713	1N4005	100413	1
	CR33	Diode, Signal: 50 V	03508	1N4151	100385	1

EQUIPMENT/ASSEMBLY DESIGNATION: A3, ANALOG P.C. ASSEMBLY #03757491 (Cont'd)

(1) DESIGNATOR ITEM	(1) DESIGNATOR REF	(2) COMPONENT NOMENCLATURE AND DESCRIPTION	(3) MFR'S CODE	(4) MANUFACTURER'S PART NUMBER	(5) SD STOCK NO.	(6) T/Q
	CR34	Diode, Signal: 50 V	03508	1N4151	100385	1
	CR35	Diode, Signal: 50 V	03508	1N4151	100385	1
	CR36	Diode, Signal: 50 V	03508	1N5141	100385	1
	CR37	Diode, Signal: 125 V	13715	FD-300	102703	1
	CR38	Diode, Signal: 125 V	13715	FD-300	102703	1
	Q1	Semiconductor Device, Transistor: JFET N-channel, Dual	15818	SU2365A	101407	1
	Q2	Semiconductor Device, Transistor: Silicon, NPN	07263	2N3694	102714	1
	Q3	Semiconductor Device, Transistor: Silicon, PNP	04713	MPS6523	101429	1
	Q4	Semiconductor Device, Transistor: Silicon, PNP	04713	MPS6523	101429	1
	Q5	Semiconductor Device, Transistor: Silicon, NPN	07263	2N3694	102714	1
	Q6	Semiconductor Device, Transistor: Silicon, NPN	04713	MPS6521	101430	1
	Q7	Semiconductor Device, Transistor: Silicon, PNP	04713	MPS6523	101429	1
	Q8	Semiconductor Device, Transistor: Red Dot, Selected	52542	03759801	03759801	1
	Q9	Semiconductor Device, Transistor: Silicon, NPN	07263	2N3565	101371	1
	Q10	Semiconductor Device, Transistor: Silicon, PNP	07263	2N4250	102725	1
	Q11	Semiconductor Device, Transistor: Silicon, NPN	07263	2N2484	102681	1
	Q12	Semiconductor Device, Transistor: Silicon, PNP	07263	2N4250	102725	1
	Q13	Semiconductor Device, Transistor: MOSFET, PCH	32293	2N155A	101424	1
	Q14	Semiconductor Device, Transistor: JFET N-channel	01295	2N4393	101417	1
	Q15	Semiconductor Device, Transistor: Red Dot, Selected	52542	03759801	03759801	1
	Q16	Semiconductor Device, Transistor: Silicon NPN	07263	2N3565	101371	1
	Q17	Semiconductor Device, Transistor: JFET N-channel	22229	KE4392	101423	1
	Q18	Semiconductor Device, Transistor: JFET N-channel	22229	KE4392	101423	1
	Q19	Semiconductor Device, Transistor: JFET N-channel	22229	KE4392	101423	1
	Q20	Not Used				
	Q21	Semiconductor Device, Transistor: JFET N-channel, Dual	22229	KE3954	102717	1
	Q22	Semiconductor Device, Transistor: Silicon, NPN	07263	2N3694	102714	1
	Q23	Semiconductor Device, Transistor: Silicon, PNP	07263	2N4250	102725	1
	Q24	Semiconductor Device, Transistor: Silicon, PNP	07263	2N4250	102725	1
	Q25	Semiconductor Device, Transistor: Silicon, NPN	07263	2N3694	102714	1
	Q26	Semiconductor Device, Transistor: Silicon, NPN	07263	2N3694	102714	1
	Q27	Semiconductor Device, Transistor: Silicon, PNP	07263	2N4917	102726	1

EQUIPMENT/ASSEMBLY DESIGNATION: A3, ANALOG P.C. ASSEMBLY #03757491 (Cont'd)

(1) DESIGNATOR ITEM	(1) DESIGNATOR REF	(2) COMPONENT NOMENCLATURE AND DESCRIPTION	(3) MFR'S CODE	(4) MANUFACTURER'S PART NUMBER	(5) SD STOCK NO.	(6) T/Q
	Q28	Not Used				
	Q29	Semiconductor Device, Transistor: Red Dot, Selected	52542	037592	037592	1
	Q30	Semiconductor Device, Transistor: JFET N-channel	01295	2N4393	101417	1
	Q31	Semiconductor Device, Transistor: Silicon, PNP	07263	2N3640	101357	1
	Q32	Semiconductor Device, Transistor: Silicon, NPN	07263	2N4275	102716	1
	Q33	Semiconductor Device, Transistor: Silicon, PNP	07263	2N4121	102713	1
	Q34	Semiconductor Device, Transistor: Silicon, NPN	07263	2N4275	102716	1
	Q35	Semiconductor Device, Transistor: Silicon, PNP	07263	2N4121	102713	1
	Q36	Semiconductor Device, Transistor: Silicon, NPN	07263	2N4275	102716	1
	Q37	Semiconductor Device, Transistor: Silicon, PNP	07263	2N4121	102713	1
	Q38	Semiconductor Device, Transistor: Silicon, NPN	07263	2N4275	102716	1
	Q39	Semiconductor Device, Transistor: Silicon, PNP	07263	2N4121	102713	1
	Q40	Semiconductor Device, Transistor: Silicon, PNP	07263	2N3640	101357	1
	Q41	Semiconductor Device, Transistor: Silicon, NPN	07263	2N4275	102716	1
	Q42	Semiconductor Device, Transistor: Silicon, PNP	07256	2N5415	Q0277	1
	Q43	Semiconductor Device, Transistor: Silicon, NPN	07263	2N3565	101371	1
	Q44	Semiconductor Device, Transistor: Silicon, NPN	02735	2N6103	101418	1
	R1	Resistor Comp: 1.0101 k 1/4 W, Ratio Matched	52542	037599	037599	1
	R2	Resistor Comp: 11.111 k 1/4 W, Ratio Matched	52542	037599	037599	1
	R3	Resistor Comp: 111.11 k 1/4 W, Ratio Matched	52542	037599	037599	1
	R4	Resistor Comp: .1 M 1 W, Ratio Matched	52542	037599	037599	1
	R5	Resistor Comp: 20 k 1%, 1/2 W	91637	MFF-1/2 T1	102483	1
	R6	Resistor, Potentiometer: 5 k	73138	89PR5K	102473	2
	R7	Resistor Comp: 7.50 k 1%, 1/8 W	91637	MFF-1/8 T1	102278	1
	R8	Resistor Comp: 1.0 k 1%, 1/8 W	19701	MF5C-E-1001-F	101931	1
	R9	Resistor Comp: 35.7 k .1% 1/8 W	91637	MFF-1/8 T9	102249	1
	R10	Resistor Comp: 20 k 1%, 1/4 W	91637	MFF-1/4 T1	102202	1
	R11	Not Used				
	R12	Resistor Comp: 100 Ω 1%, 1/8 W	19701	MF5C-E-1000F	102034	1
	R13	Resistor, Potentiometer: 50 Ω	18612	1203-Y-50	102242	1
	R14	Resistor Comp: 15.8 k 1%, 1/8 W	91637	MFF-1/8 T9	102250	1
	R15	Resistor, Potentiometer: 2 k	73138	89PR2K	102119	1
	R16	Resistor Comp: 35.7 k .1%, 1/8 W	91637	MFF-1/8 T9	1 2 19	1
	R17	Resistor Comp: 750 Ω 5%, 1/4 W	01121	CB7515	101689	1
	R18	Resistor Comp: 1.62 k 1%, 1/8 W	91637	MFF-1/8 T1	102195	1
	R19	Resistor Comp: 3.16 k 1%, 1/4 W	91637	MFF-1/8 T1	102197	1

EQUIPMENT/ASSEMBLY DESIGNATION A3, ANALOG P.C. ASSEMBLY #03757491 (Cont'd)

(1) DESIGNATOR ITEM	(1) DESIGNATOR REF	(2) COMPONENT NOMENCLATURE AND DESCRIPTION	(3) MFR'S CODE	(4) MANUFACTURER'S PART NUMBER	(5) SD STOCK NO.	(6) T/Q
	R20	Resistor Comp: 1 k 5%, 1/4 W	01121	CB1025	101569	1
	R21	Resistor Comp: 200 Ω 5%, 1/4 W	01121	CB2015	101555	1
	R22	Resistor Comp: 1 k 5%, 1/4 W	01121	CB1025	101569	1
	R23	Resistor Comp: 1.0 k 1%, 1/8 W	19701	MF5C-E-1001-F	101931	1
	R24	Resistor Comp: 1.0 k 1%, 1/8 W	19701	MF5C-E-1001-F	101931	1
	R25	Resistor Comp: 1 M 1%, 1/8 W	03888	PME60T9	101966	1
	R26	Resistor Comp: 1 M 1%, 1/8 W	03888	PME60T9	101966	1
	R27	Resistor Comp: 1 M 1%, 1/8 W	03888	PME60T9	101966	1
	R28	Resistor Comp: 1 M 1%, 1/8 W	03888	PME60T9	191966	1
	R29	Resistor Comp: 900 Ω .1%, .3 W	18612	V53-1	102176	1
	R30	Resistor Comp: 90 Ω .1%, .3 W	18612	V53-1	102177	1
	R31	Resistor Comp: 9 Ω .1%, 1/2 W	18612	V53-5	102178	1
	R32	Resistor Comp: .9 Ω .1%, 1 W	18612	1203-Y-1K	102280	1
	R33	Resistor Comp: .1 Ω .1%, 2 W	15915	TSK2W2B	102281	1
	R34	Resistor Potentiometer: 50 k	73138	89PR50K	102153	1
	R35	Resistor Comp: 8.980 M .1%, 2 W	52542	037601	037601	1
	R36	Resistor Comp: 900 k .01%, 1/2 W	52542	037601	037601	1
	R37	Resistor Comp: 90 k .01%, 1/2 W	52542	037601	037601	1
	R38	Resistor Comp: 9980 Ω .1%, 3 W	52542	037601	037601	1
	R39	Resistor Potentiometer: 50 Ω	73138	89PR50	102184	1
	R40	Resistor Comp: 499 k 1%, 1/2 W	91637	MFF-1/2 T1	102247	1
	R41	Resistor Comp: 499 k 1%, 1/2 W	91637	MFF-1/2 T1	102247	1
	R42	Resistor Comp: 1 M 1%, 1/8 W	19701	MF5C-D-1004-F	101907	1
	R43	Resistor Comp: 43.2 k .1%, .3 W	18612	V53-1	100012	1
	R44	Resistor Comp: 20 k 5%, 1/2 W	01121	CB2035	101607	1
	R45	Resistor Comp: 2.2 k 5%, 1/4 W	01121	CB2225	101562	1
	R46	Resistor Comp: 30.1 Ω 1%, 1/8 W	91637	MFF-1/8 T9	100016	1
	R47	Resistor, Potentiometer: 50 Ω	18612	1203-Y-50	102242	1
	R48	Resistor, Potentiometer: 1 k	18612	1203-Y-1K	102280	1
	R49	Resistor Comp: 43.2 k .1%, .3 W	18612	V53-1	100012	1
	R50	Not Used				
	R51	Resistor Comp: 15.8 k 1%, .3 W	18612	V53-1	100017	1
	R52	Resistor Comp: 100 Ω 5%, 1/4 W	01121	CB1015	101609	1
	R53	Resistor Comp: 1.2 k 5%, 1/2 W	01121	EB1225	101455	
	R54	Resistor Comp: 9 k .1%, .3 W	18612	V53-1	102274	1
	R55	Resistor Comp: 998 Ω .1%, .3 W	18612	V53-1	102265	1
	R56	Resistor Comp: 10 Ω 1%, 1/8 W	91637	MFF-1/8 T9	102243	1
	R57	Resistor Potentiometer: 10 Ω	73138	89PR10	102156	1
	R58	Not Used				
	R59	Resistor Comp: 100 Ω 1%, 1/8 W	19701	MF5C-E-1000F	102034	1
	R60	Resistor Comp: 10 Ω 1%, 1/8 W	91637	MFF-1/8 T9	102243	1
	R61	Resistor Comp: 49.9 k 1%, 1/8 W	91637	MFF-1/8 T1	102082	1
	R62	Resistor Comp: 274 k 1%, 1/8 W	19701	MF5C-D-2743-F	102101	1
	R63	Resistor Comp: 3.23 k 1%, 1/4 W	91637	MFF-1/8 T1	102114	1
	R64	Resistor Comp: 499 k 1%, 1/8 W	19701	MF5C-D-4993-F	101908	1
	R65	Resistor Comp: 68.1 k 1%, 1/8 W	91637	MFF-1/8 T1	102245	1
	R66	Resistor Comp: 1.5 k 1%, 1/8 W	91637	MFF-1/8 T1	102251	1
	R67	Resistor Comp: 33.2 k 1%, 1/8 W	19701	MF5C-D-3322-F	102143	1
	R68	Resistor Comp: 47 Ω 5%, 1/4 W	01121	CB4705	101560	1

EQUIPMENT/ASSEMBLY DESIGNATION A3, ANALOG P.C. ASSEMBLY #03757491 (Cont'd)

(1) DESIGNATOR ITEM	(1) DESIGNATOR REF	(2) COMPONENT NOMENCLATURE AND DESCRIPTION	(3) MFR'S CODE	(4) MANUFACTURER'S PART NUMBER	(5) SD STOCK NO.	(6) T/Q
	R69	Resistor Comp: 4.7 k 5%, 1/4 W	01121	CB4725	101598	1
	R70	Resistor Comp: .15 k 5%, 1/4 W	01121	CB1535	101552	1
	R71	Resistor Comp: 2.2 k 5%, 1/4 W	01121	CB2225	101562	1
	R72	Resistor Comp: 10 k 5%, 1/4 W	01121	CB1035	101570	1
	R73	Resistor Comp: 12 k 5%, 1/4 W	01121	CB1235	101565	1
	R74	Resistor Comp: 35.7 k .1%, .3 W	18612	V53-1	100008	1
	R75	Resistor Comp: 22 M 5%, 1/4 W	01121	CB2265	101628	1
	R76	Resistor Potentiometer: 500 Ω	18612	V53-1	100007	1
	R77	Resistor Comp: 2.2 k 5%, 1/4 W	01121	CB2225	101562	1
	R78	Resistor Comp: 30.1 Ω .1% 1/8 W	91637	MFF-1/8 T9	100016	1
	R79	Resistor, Potentiometer: 50 Ω	18612	1203-Y-50	102242	1
	R80	Resistor Comp: 15.8 k 1%, .3 W	18612	V53-1	100017	1
	R81	Resistor Comp: 35.7 k .1%, .3 W	18612	V53-1	100008	1
	R82	Resistor Comp: 22 Ω 5%, 1/4 W	01121	CB2205	101696	1
	R83	Resistor Comp: 22 Ω 5%, 1/4 W	01121	CB2205	101696	1
	R84	Resistor, Potentiometer: 2 k	80294	3329H-1-202	101915	1
	R85	Resistor Comp: 100 Ω 5%, 1/4 W	01121	CB1015	101609	1
	R86	Resistor Comp: 2.01 k .1%, .3 W	18612	V53-1	102266	1
	R87	Resistor, Potentiometer: 20 Ω	73138	89PR20	102154	1
	R88	Resistor Comp: 200 k .02%, 1 W	18612	V53-7	102276	1
	R89	Resistor Comp: 22.172 k .02%, .3 W	18612	V53-1	102275	1
	R90	Resistor, Potentiometer: 100 Ω	73138	89PR100	102240	1
	R91	Resistor Comp: 49.9 Ω 1%, 1/10 W	19701	MF4C-E-49R9-F	102090	1
	R92	Resistor, Factory Selected	- - -	- - - - - - -	XXXXXX	-
	R93	Resistor, Potentiometer: 200 Ω	73138	89PR200	102120	1
	R94	Resistor Comp: 2.2 k 5%, 1/4 W	01121	CB2225	101562	1
	R95	Resistor, Potentiometer: 100 W	73138	89PR100	102240	1
	R96	Resistor Comp: 6.175 k .1%, .3 W	18612	V53-1	102273	1
	R97	Resistor, Factory Selected	- - -	- - - - - - -	XXXXXX	-
	R98	Resistor Comp: 100 Ω 5%, 1/4 W	01121	CB1015	101609	1
	R99	Resistor, Factory Selected	- - -	- - - - - - -	XXXXXX	-
	R100	Resistor Comp: 750 Ω 1%, 1/8 W	91637	MFF-1/8 T1	102252	1
	R101	Resistor Comp: 10 k .1%, .3 W	18612	V53-1	102284	1
	R102	Resistor Comp: 560 k 5%, 1/4 W	01121	CB5645	101687	1
	R103	Resistor, Potentiometer: 100 Ω	73138	89PR100	102240	1
	R104	Resistor Comp: 49.9 Ω 1%, 1/10 W	19701	MF4C-E-49R9-F	102090	1
	R105	Resistor Comp: 470 Ω 5%, 1/4 W	01121	CB4715	101625	1
	R106	Resistor Comp: 10 k .1%, .3 W	18612	V53-1	102284	1
	R107	Not Used				
	R108	Resistor Comp: 560 k 5%, 1/4 W	01121	CB5645	101687	1
	R109	Not Used				
	R110	Not Used				
	R111	Resistor, Potentiometer: 2 M	73138	89PR2M	102241	1
	R112	Resistor Comp: 6.81 M 1%, 1/2 W	91637	MFF-1/2 T1	102279	1
	R113	Resistor Comp: 4.99 k 1%, 1/8 W	91637	MFF-1/8 T1	102079	1
	R114	Resistor Comp: 35.7 k 1%, 1/8 W	19701	MF5C-D-3572-F	102144	1
	R115	Not Used				
	R116	Not Used				
	R117	Resistor Comp: 15.8 k 1%, 1/8 W	91637	MFF-1/8 T1	102232	1
	R118	Resistor Comp: 35.7 k 1%, 1/8 W	19701	MF5C-D-3572-F	102144	1

EQUIPMENT/ASSEMBLY DESIGNATION A3, ANALOG P.C. ASSEMBLY #03757491 (Cont'd)

(1) DESIGNATOR ITEM	(1) DESIGNATOR REF	(2) COMPONENT NOMENCLATURE AND DESCRIPTION	(3) MFR'S CODE	(4) MANUFACTURER'S PART NUMBER	(5) SD STOCK NO.	(6) T/Q
	R119	Resistor Comp: 12 k 5%, 1/4 W	01121	CB1235	101565	1
	R120	Not Used				
	R121	Resistor Comp: 3.32 k 1%, 1/4 W	91637	MFF-1/8 T1	102114	1
	R122	Resistor Comp: 6.19 k 1%, 1/4 W	91637	MFF-1/8 T1	102199	1
	R123	Resistor Comp: 47 Ω 5%, 1/4 W	01121	CB4705	101560	1
	R124	Resistor Comp: 150 Ω 5%, 1/4 W	01121	CB1515	101615	1
	R125	Resistor Comp: 150 Ω 5%, 1/4 W	01121	CB1515	101615	1
	R126	Resistor Comp: 47 Ω 5%, 1/4 W	01121	CB4705	101560	1
	R127	Resistor Comp: 10 k 5%, 1/4 W	01121	CB1035	101570	1
	R128	Resistor Comp: 10 k 5%, 1/4 W	01121	CB1035	101570	1
	R129	Resistor Comp: 3.3 M 5%, 1/4 W	01121	CB3355	101660	1
	R130	Resistor Comp: 150 k 5%, 1/4 W	01121	CB1545	101604	1
	R131	Resistor Comp: 510 Ω 5%, 1/4 W	01121	CB5115	101616	1
	R132	Resistor Comp: 33 k 5%, 1/4 W	01121	CB3335	101576	1
	R133	Not Used				
	R134	Resistor Comp: 33 k 5%, 14/ W	01121	CB3335	101576	1
	R135	Resistor Comp: 68 k 5%, 1/4 W	01121	CB6835	101597	1
	R136	Resistor Comp: 4.7 k 5%, 1/4 W	01121	CB4725	101598	1
	R137	Not Used				
	R138	Resistor Comp: 4.7 k 5%, 1/4 W	01121	CB4725	101598	1
	R139	Not Used				
	R140	Resistor Comp: 100 k 5%, 1/4 W	01121	CB1045	101558	1
	R141	Resistor Comp: 100 Ω 5%, 1/4 W	01121	CB1015	101609	1
	R142	Resistor Comp: 47 Ω 5%, 1/4 W	01121	CB4705	101560	1
	R143	Resistor Comp: 33 k 5%, 1/4 W	01121	CB3335	101576	1
	R144	Resistor Comp: 4.7 k 5%, 1/4 W	01121	CB4725	101598	1
	R145	Resistor Comp: 10 k 5%, 1/4 W	01121	CB1035	101570	1
	R146	Resistor, Potentiometer: 200 Ω	80294	3329H-1-201	101921	1
	R147	Resistor Comp: 12 k 5%, 1/4 W	01121	CB1235	101565	1
	R148	Resistor Comp: 68 k 5%, 1/4 W	01121	CB6835	101597	1
	R149	Not Used				
	R150	Resistor Comp: 7.5 k 5%, 1/4 W	01121	CB7525	101596	1
	R151	Resistor Comp: 12 k 5%, 1/4 W	01121	CB1235	101565	1
	R152	Not Used				
	R153	Resistor Comp: 33 k 5%, 1/4 W	01121	CB3335	101576	1
	R154	Not Used				
	R155	Resistor Comp: 12 k 5%, 1/4 W	01121	CB1235	101565	1
	R156	Resistor Comp: 4.7 k 5%, 1/4 W	01121	CB4725	101598	1
	R157	Resistor Comp: 10 k 5%, 1/4 W	01121	CB1035	101570	1
	R158	Resistor Comp: 82 k 5%, 1/4 W	01121	CB8235	101578	1
	R159	Resistor Comp: 12 k 5%, 1/4 W	01121	CB1235	101565	1
	R160	Resistor Comp: 1 M 5%, 1/4 W	01121	CB1055	101605	1
	R161	Resistor Comp: 1.8 k 5%, 1/4 W	01121	CB1825	101602	1
	R162	Resistor Comp: 47 k 5%, 14/ W	01121	CB4735	101574	1
	R163	Resistor Comp: 1 M 1%, 1/8 W	19701	MF5C-D-1004-F	101907	1
	R164	Resistor Comp: 90.9 k 1%, 1/8 W	19701	MF5C-D-9092-F	102158	1
	R165	Resistor Comp: 71.5 k 1%, 1/8 W	91637	MFF-1/8 T1	102248	1
	R166	Resistor Comp: 39.2 k 1%, 1/8 W	19701	MF5C-D-3922-F	102147	1
	R167	Resistor, Potentiometer: 5 k	73138	89PR5K	102473	1

EQUIPMENT/ASSEMBLY DESIGNATION: A3, ANALOG P.C. ASSEMBLY #03757491 (Cont'd)

(1) DESIGNATOR ITEM	(1) DESIGNATOR REF	(2) COMPONENT NOMENCLATURE AND DESCRIPTION	(3) MFR'S CODE	(4) MANUFACTURER'S PART NUMBER	(5) SD STOCK NO.	(6) T/Q
	R168	Resistor Comp: 1 Ω 5%, 2 W	75042	BWH	102214	1
	R169	Resistor Comp: 47 Ω 5%, 1/4 W	01121	CB4705	101560	1
	R170	Resistor, Potentiometer: 200 Ω	73138	89PR200	102120	1
	R171	Resistor, Potentiometer: 50 Ω	73138	89PR50	102184	1
	R172	Resistor Comp: 100 Ω 1%, 1/8 W	19701	MF5C-E-1000F	102034	1
	R173	Resistor Comp: 4.7 k 5%, 1/4 W	01121	CB4725	101598	1
	R174	Resistor Comp: 1 M 5%, 1/4 W	01121	CB1055	101605	1
	TP1	Test Point, Brown	91506	8041-1G3	100521	1
	TP2	Test Point, Red	91506	8041-1G4	100522	1
	TP3	Test Point, Orange	91506	8041-1G5	100523	1
	TP4	Test Point, Yellow	91506	8041-1G2	100524	1
	TP5	Test Point, Green	91506	8041-1G7	100525	1
	TP6	Test Point, Blue	91506	8041-1G8	100526	1
	TP7	Test Point, Violet	91506	8041-1G11	100527	1
	TP8	Test Point, Grey	91506	8041-1G10	100528	1
	TP9	Test Point, Black	91506	8041-1G6	100520	1
	TP10	Test Point, White	91506	8041-1G9	10529	1
	U1	Integrated Circuit: Operational Amplifier	27014	LM201AH	025758	1
	U2	Integrated Circuit: Operational Amplifier	27014	LM201AH	025758	1
	U3	Integrated Circuit: Operational Amplifier	27014	LM201AH	025758	1
	U4	Integrated Circuit: Operational Amplifier	27014	LM201AH	025758	1
	U5	Integrated Circuit: Voltage Regulator	07933	RC4194TK1T0-661	045231	1
	VR1	Semiconductor Device, Transistor: Silicon, NPN	07263	2N3565	101371	1
	VR2	Semiconductor Device, Transistor: Silicon, NPN	07263	2N3565	101371	1
	VR3	Diode, Zener: 4.3 V	04713	1N4731	100465	1
	VR4	Not Used				
	VR5	Diode, Green Dot Selected	52542	037591	037591	1
	VR6	Semiconductor Device, Transistor: Silicon, NPN	07263	2N3565	101371	1
	VR7	Semiconductor Device, Transistor: Silicon, NPN	07263	2N3565	101371	1
	VR8	Diode, Ref: 6.2 V	04713	MZ620	100446	1
	VR9	Diode, Zener: 13 V	04713	1N4743A	100014	1
	VR10	Diode, Zener: 12 V	04713	1N963B	100390	1
	VR11	Diode, Green Dot Selected	52542	037591	037591	1
	VR12	Diode, Red Dot Selected	52542	037486	037486	1
	VR13	Diode, Red Dot Selected	52542	037486	037486	1
	VR14	Diode, Red Dot Selected	52542	037486	037486	1
	VR15	Semiconductor Device, Transistor: Silicon, NPN	07263	2N3565	101371	1
	VR16	Semiconductor Device, Transistor: Silicon, NPN	07263	2N3565	101371	1
	VR17	Diode, Zener: 4.3 V	04713	1N4731	100465	1
	VR18	Diode, Zener: 4.3 V	04713	1N4731	100465	1
	VR19	Diode, Red Dot Selected	52542	037486	037486	1
	VR20	Diode, Red Dot Selected	52542	037486	037486	1
		Terminal, Insulated	71279	4034-3-0519	102773	20
		Terminal, Insulated Feed-thru			102974	2
		Terminal	88245	2000B	100482	9

EQUIPMENT/ASSEMBLY DESIGNATION A3, ANALOG P.C. ASSEMBLY #03757491 (Cont'd)

(1) DESIGNATOR ITEM	(1) DESIGNATOR REF	(2) COMPONENT NOMENCLATURE AND DESCRIPTION	(3) MFR'S CODE	(4) MANUFACTURER'S PART NUMBER	(5) SD STOCK NO.	(6) T/Q
		Swage, Standoff, 4-40 X 1/4	83330	4142	100537	2
		Receptacle, Cloverleaf	98921	011-6808	101262	3
		Screw, Pan Head Machine: 4-40 X 1/4	MIL	MS51957-13	10062604	2
		Nut, #4 Hex	MIL	NAS671C4	100622	2
		Washer, # 4 split-lock	MIL	MS35338-135	100711	2

EQUIPMENT/ASSEMBLY DESIGNATION SWITCH ASSEMBLY #03757493

(1) DESIGNATOR ITEM	(1) DESIGNATOR REF	(2) COMPONENT NOMENCLATURE AND DESCRIPTION	(3) MFR'S CODE	(4) MANUFACTURER'S PART NUMBER	(5) SD STOCK NO.	(6) T/Q
		Switch Wiring Assembly	52542	03757493	03757493	1
		Switch Wiring Schematic	52542	7-03757401	7-03757401	1
	C62	Capacitor: .01 µF +80-20%, 100 V	91418	TA110	100103	1
	C63	Capacitor: .01 µF +80-20%, 100 V	91418	TA110	100103	1
	CR31	Diode, Zener: 600 V, 1A	04713	1N4005	100413	1
	CR32	Diode, Zener: 600 V, 1A	04713	1N4005	100413	1
	F1	Fuse, 2 A	75915	275002	100605	1
	F3	Fuse, 1/8 A	75915	275.125	100606	1
	F4	Fuse, 1/4 A	75915	275.250	100609	1
	R29	Resistor, Comp: 900 Ω .1%, .3 W	18612	V53-1	102176	1
	R30	Resistor, Comp: 90 Ω .1%, .3 W	18612	V53-1	102177	1
	R31	Resistor, Comp: 9 Ω .1%, 1/2 W	18612	V53-5	102178	1
	R32	Resistor, Comp: .9 Ω .1%, 1 W	15915	NS-1A	102282	1
	R33	Resistor, Comp: .1 Ω .1%, 2 W	15915	TSK2W2B	103381	1
	R40	Resistor, Comp: 499 k 1%, 1/2 W	91637	MFF-1/2 T1	102247	1
	R41	Resistor, Comp: 499 k 1%, 1/2 W	91637	MFF-1/2 T1	102247	1
	R42	Resistor, Comp: 1 M 1%, 1/8 W	19701	MF5C-D-1004-F	101907	1
	R54	Resistor, Comp: 9 k .1%, .3 W	18612	V53-1	102274	1
	R55	Resistor, Comp: 998 Ω .1%, .3 W	18612	V53-1	102265	1
	R75	Resistor, Comp: 22 M 5%, 1/2 W	01121	CB2265	101628	1
	VR17	Diode, Zener: 4.3 V, 10% 1 W	04713	1N4731	100465	1
	VR18	Diode, Zener: 4.3 V, 10% 1W	04713	1N4731	100465	1
		Tie, Cable: 0-3/4 nylon	06383	SSTIM	100753	2

5.4 PARTS LIST (Cont'd)

EQUIPMENT/ASSEMBLY DESIGNATION: SWITCH ANALOG P.C. ASSEMBLY #03757401

(1) DESIGNATOR ITEM	(1) DESIGNATOR REF	(2) COMPONENT NOMENCLATURE AND DESCRIPTION	(3) MFR'S CODE	(4) MANUFACTURER'S PART NUMBER	(5) SD STOCK NO.	(6) T/Q
		Switch Analog P.C. Assembly	52542	03757401	03757401	1
		Switch Analog P.C. Schematic	52542	7-03757401	7-03757401	1
	C1	Capacitor: .1 F, 1200 V	12406	ZD12A104	102593	1
	C2	Capacitor: .8-8.5 pF 1000 V	73899	VC9GWY	100334	1
	C4	Capacitor: .8-8.5 pF 1000 V	73899	VC9GWY	100334	1
	C6	Capacitor: .8-8.5 pF 1000 V	73899	VC9GWY	100334	1
	C8	Capacitor: .8-8.5 pF 1000 V	73899	VC9GWY	100334	1
	C10	Capacitor: 15 pF 1 kV	56289	10TCC-Q15	100355	1
	Q13	Semiconductor Device, Transistor: MOSFET	32293	3N155A	101424	1
	R34	Resistor Comp: Potentiometer 50 k	73138	89PR50K	102153	1
	R35	Resistor Comp: 8.980 M .1%, 2 W	52542	037601	037601	1
	R36	Resistor Comp: 900 k .01%, 1/2 W	52542	037601	037601	1
	R37	Resistor Comp: 90 k .01%, 1/2 W	52542	037601	037601	1
	R38	Resistor Comp: 9980 Ω .1%, 3 W	52542	037601	037601	1
	R84	Resistor Comp: Potentiometer 2 k	80294	3329H-1-202	101915	1
	R92	Resistor Comp: FACTORY SELECT	- -	- - - - -	XXXXXX	1
	R97	Resistor Comp: FACTORY SELECT	- -	- - - - -	XXXXXX	1
	R99	Resistor Comp: FACTORY SELECT	- -	- - - - -	XXXXXX	1
	R146	Resistor Comp: Potentiometer 200 Ω	80294	3329H-1-201	101921	1
	R170	Resistor Comp: Potentiometer 200 Ω	73138	89PR200	102120	1
	R171	Resistor Comp: Potentiometer 50 Ω	73138	89PR50	102184	1
	VR8	Diode, Ref., 6.2 V	04713	MZ620	100446	1
		Heatsink	13103	1115B	101071	1
		Adapter, Potentiometer	73138	89B	102820	2
		Cable Assembly, Flex	52542	037584	037584	1
		Kit, Supply Reference	52542	037828	037828	1

EQUIPMENT/ASSEMBLY DESIGNATION: BCD P.C. BOARD ASSEMBLY #03778401

(1) DESIGNATOR ITEM	(1) DESIGNATOR REF	(2) COMPONENT NOMENCLATURE AND DESCRIPTION	(3) MFR'S CODE	(4) MANUFACTURER'S PART NUMBER	(5) SD STOCK NO.	(6) T/Q
	C1	Capacitor, .05 µF, 10 V	71590	UK10-503	100122	1
	C2	Capacitor, .15 µF, 100 V	18489	VMR154K1	102589	1
	C3	Capacitor, .001 µF, 1 k V	91418	TYPE B	100076	1
	C4	Capacitor, .001 µF, 1 k V	91418	TYPE B	100076	1
	C5	Capacitor, 3.3 µF, 15 V	56289	150D335X9015A2	100204	1
	C6	Capacitor, .001 µF, 1 k V	91418	TYPE B	100076	1
	C7	Capacitor, .001 µF, 1 k V	91418	TYPE B	100076	1
	C8	Capacitor, 39 µF, 10 V	56289	150D396X9010B2	100183	1
	C9	Capacitor, .005 µF, 150 V	71590	DDM502	100058	1
	C10	Capacitor, .001 µF, 1 k V	91418	TYPE B	100076	1
	C11	Capacitor, 10 µF, 20 V	56289	150D106X9020B2	100063	1
	C12	Capacitor, 2500 µF, 15 V	56289	TVL1714	100247	1
	C13	Capacitor, 10 µF, 20 V	56289	150D106X9020B2	100063	1
	C14	Capacitor, .05 µF, 10 V	71590	UK10-503	100122	1
	C15	Capacitor, .01 µF, 500 V	91418	TYPE SM	100075	1
	C16	Capacitor, .05 µF, 10 V	71590	UK10-503	100122	1
	C17	Capacitor, .05 µF, 10 V	71590	UK10-503	100122	1
	C18	Capacitor, .05 µF, 10 V	71590	UK10-503	100122	1
	C19	Capacitor, .05 µF, 10 V	71590	UK10-503	100122	1
	CR1	Diode, Rectifier, 600 V	04713	1N4005	100413	1
	CR2	Diode, Rectifier, 600 V	04713	1N4005	100413	1
	CR3	Diode, Rectifier, 600 V	04713	1N4005	100413	1
	CR4	Diode, Rectifier, 600 V	04713	1N4005	100413	1
	Q1	Semiconductor Device, Transistor: Silicon, NPN	07263	2N4275	102716	1
	Q2	Semiconductor Device, Transistor: Silicon, NPN	07263	2N4275	102716	1
	Q3	Semiconductor Device, Transistor: Silicon, NPN	07263	2N4275	102716	1
	Q4	Semiconductor Device, Transistor: Silicon, NPN	04713	MPS-A12	101396	1
	Q5	Semiconductor Device, Transistor: Silicon, PNP	07263	2N4250	102725	1
	R1	Resistor, Comp: 3 k 5%, 1/4 W	01121	CB3025	101548	1
	R2	Resistor, Comp: 680 Ω 5%, 1/4 W	01121	CB6815	101669	1
	R3	Resistor, Comp: 680 Ω 5%, 14/ W	01121	CB6815	101669	1
	R4	Resistor, Comp: 680 Ω 5%, 1/4 W	01121	CB6815	101669	1
	R5	Resistor, Comp: 680 Ω 5%, 1/4 W	01121	CB6815	101669	1
	R6	Resistor, Comp: 680 Ω 5%, 1/4 W	01121	CB6815	101669	1
	R7	Resistor, Comp: 680 Ω 5%, 1/4 W	01121	CB6815	101669	1
	R8	Resistor, Comp: 680 Ω 5%, 1/4 W	01121	CB6815	101669	1
	R9	Resistor, Comp: 680 Ω 5%, 1/4 W	01121	CB6815	101669	1
	R10	Resistor, Comp: 680 Ω 5%, 1/4 W	01121	CB6815	101669	1
	R11	Resistor, Comp: 680 Ω 5%, 1/4 W	01121	CB6815	101669	1
	R12	Resistor, Comp: 680 Ω 5%, 1/4 W	01121	CB6815	101669	1
	R13	Not Used				
	R14	Resistor, Comp: 10 k 5%, 1/4 W	01121	CB1035	101570	1
	R15	Resistor, Comp: 33 k 5%, 1/4 W	01121	CB3335	101576	1
	R16	Resistor, Comp: 33 k 5%, 1/4 W	01121	CB3335	101576	1
	R17	Resistor, Comp: 33 k 5%, 1/4 W	01121	CB3335	101576	1
	R18	Resistor, Comp: 33 k 5%, 1/4 W	01121	CB3335	101576	1

EQUIPMENT/ASSEMBLY DESIGNATION BCD P.C. BOARD ASSEMBLY #03778401 (Cont'd)

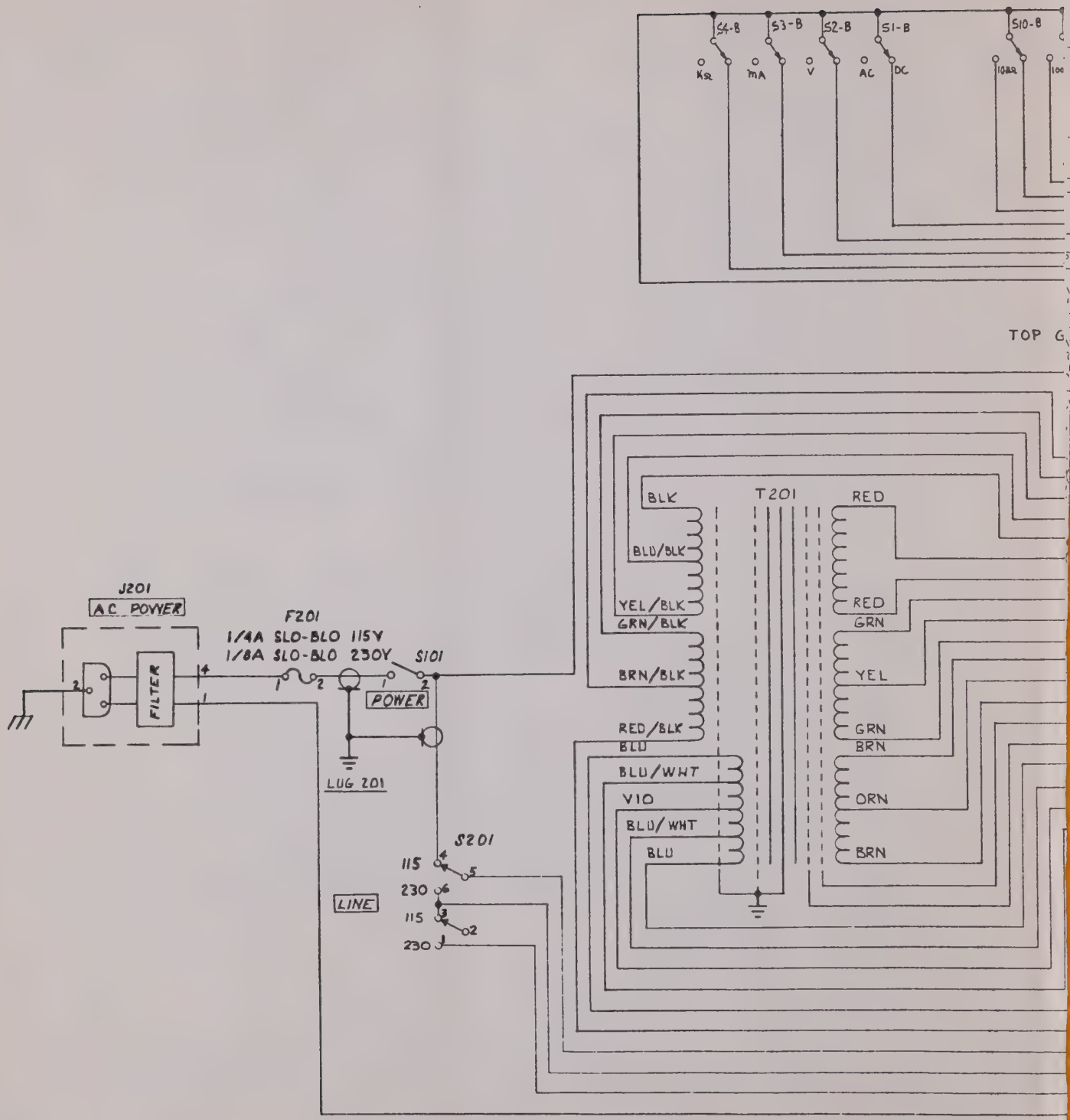
(1) DESIGNATOR ITEM	(1) DESIGNATOR REF	(2) COMPONENT NOMENCLATURE AND DESCRIPTION	(3) MFR'S CODE	(4) MANUFACTURER'S PART NUMBER	(5) SD STOCK NO.	(6) T/Q
	R19	Resistor, Comp: 33 k 5%, 1/4 W	01121	CB3335	101576	1
	R20	Resistor, Comp: 33 k 5%, 1/4 W	01121	CB3335	101576	1
	R21	Resistor, Comp: 33 k 5%, 1/4 W	01121	CB3335	101576	1
	R22	Resistor, Comp: 33 k 5%, 1/4 W	01121	CB3335	101576	1
	R23	Resistor, Comp: 33 k 5%, 1/4 W	01121	CB3335	101576	1
	R24	Resistor, Comp: 33 k 5%, 1/4 W	01121	CB3335	101576	1
	R25	Resistor, Comp: 33 k 5%, 1/4 W	01121	CB3335	101576	1
	R26	Resistor, Comp: 33 k 5%, 1/4 W	01121	CB3335	101576	1
	R27	Resistor, Comp: 33 k 5%, 1/4 W	01121	CB3335	101576	1
	R28	Resistor, Comp: 15 k 5%, 14/ W	01121	CB1535	101552	1
	R29	Not Used				
	R30	Resistor, Comp: 22 k 5%, 1/4 W	01121	CB2235	101572	1
	R31	Resistor, Comp: 22 k 5%, 1/4 W	01121	CB2235	101572	1
	R32	Resistor, Comp: 22 k 5%, 1/4 W	01121	CB2235	101572	1
	R33	Resistor, Comp: 10 k 5%, 1/4 W	01121	CB1035	101570	1
	R34	Resistor, Comp: 22 k 5%, 1/4 W	01121	CB2235	101572	1
	R35	Resistor, Comp: 22 k 5%, 1/4 W	01121	CB2235	101572	1
	R36	Resistor, Comp: 10 k 5%, 1/4 W	01121	CB1035	101570	1
	R37	Resistor, Comp: 22 k 5%, 1/4 W	01121	CB2235	101572	1
	R38	Resistor, Comp: 22 k 5%, 1/4 W	01121	CB2235	101572	1
	R39	Resistor, Comp: 3 k 5%, 1/4 W	01121	CB3025	101548	1
	R40	Resistor, Comp: 22 k 5%, 1/4 W	01121	CB2235	101572	1
	R41	Resistor, Comp: 22 k 5%, 1/4 W	01121	CB2235	101572	1
	R42	Resistor, Comp: 22 k 5%, 1/4 W	01121	CB2235	101572	1
	R43	Resistor, Comp: 22 k 5%, 1/4 W	01121	CB2235	101572	1
	R44	Resistor, Comp: 1.5 k 5%, 1/4 W	01121	CB1525	101577	1
	R45	Resistor, Comp: 1.5 k 5%, 1/4 W	01121	CB1525	101577	1
	R46	Resistor, Comp: 4.7 k 5%, 1/4 W	01121	CB4725	101598	1
	R47	Resistor, Comp: 470 k 5%, 1/4 W	01121	CB4745	101630	1
	R48	Resistor, Comp: 1 k 5%, 1/4 W	01121	CB1025	101569	1
	R49	Resistor, Comp: 3.3 k 5%, 1/4 W	01121	CB3325	101559	1
	R50	Resistor, Comp: 4.7 k 5%, 1/4 W	01121	CB4725	101598	1
	R51	Resistor, Comp: 22 k 5%, 1/4 W	01121	CB2235	101572	1
	R52	Resistor, Comp: 22 k 5%, 1/4 W	01121	CB2235	101572	1
	R53	Resistor, Comp: 3 k 5%, 1/4 W	01121	CB3025	101548	1
	R54	Resistor, Comp: 22 k 5%, 1/4 W	01121	CB2235	101572	1
	R55	Resistor, Comp: 22 k 5%, 1/4 W	01121	CB2235	101572	1
	R56	Resistor, Comp: 22 k 5%, 1/4 W	01121	CB2235	101572	1
	R57	Resistor, Comp: 22 k 5%, 1/4 W	01121	CB2235	101572	1
	R58	Resistor, Comp: 22 k 5%, 1/4 W	01121	CB2235	101572	1
	R59	Resistor, Comp: 22 k 5%, 1/4 W	01121	CB2235	101572	1
	R60	Resistor, Comp: 5.1 Ω 5%, 1/2 W	01121	EB5165	102077	1
	R61	Resistor, Comp: 1 k 5%, 1/4 W	01121	CB1025	101569	1
	R62	Resistor, Comp: 1 M 5%, 1/4 W	01121	CB1055	101605	1
	U1	Integrated Circuit, Hex Inverter, TTL	27014	DM74L04N	045268	1
	U2	Integrated Circuit, Hex Inverter, TTL	27014	DM74L04N	045268	1
	U3	Integrated Circuit, Quad 2-input NAND GATE, TTL	01295	SN74L03N	045217	1
	U4	Integrated Circuit, Quad 2-input NAND GATE, TTL	01295	SN74L03N	045217	1

EQUIPMENT/ASSEMBLY DESIGNATION BCD P.C. BOARD ASSEMBLY #03779401 (Cont'd)

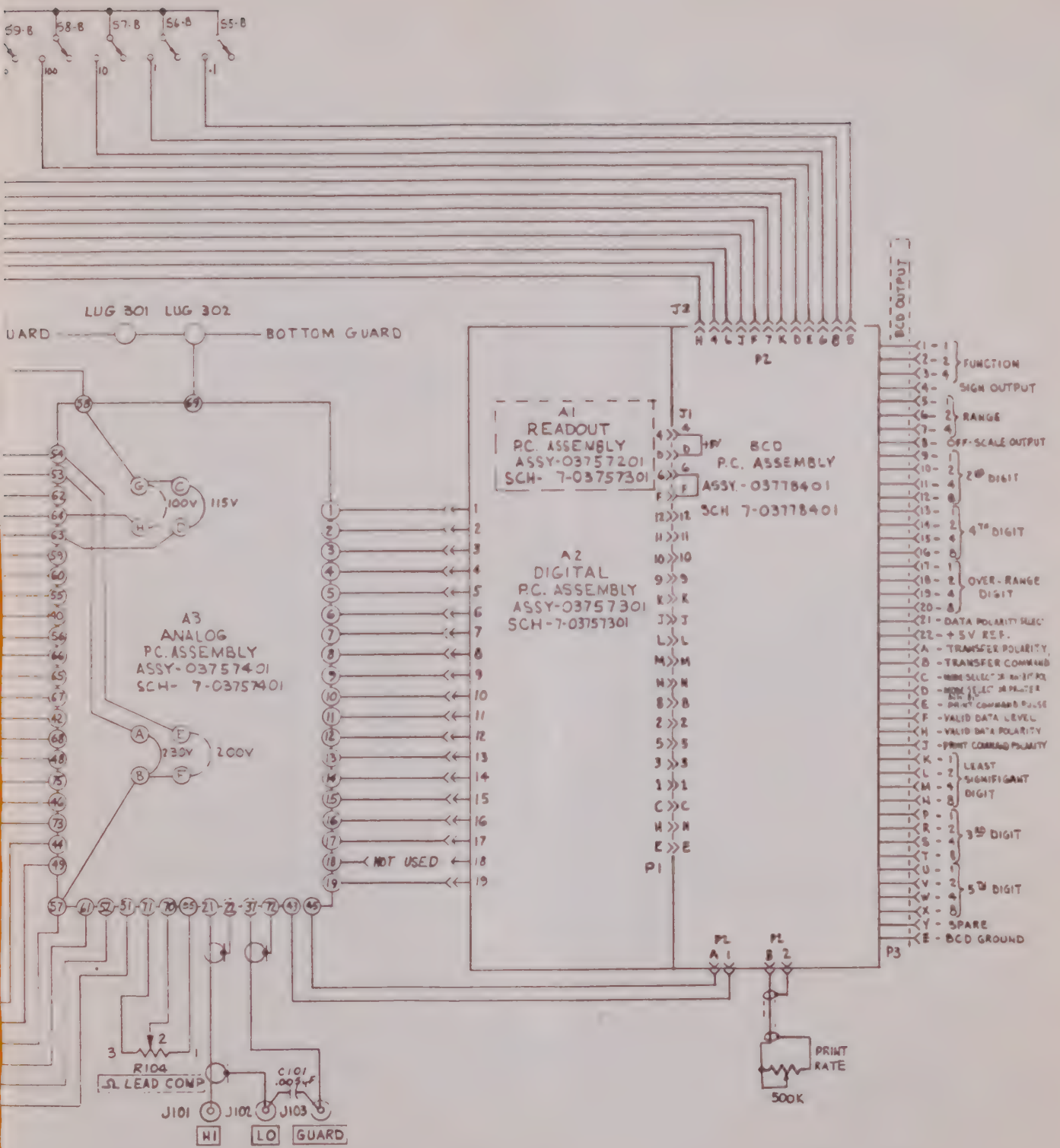
(1) DESIGNATOR ITEM	(1) DESIGNATOR REF	(2) COMPONENT NOMENCLATURE AND DESCRIPTION	(3) MFR'S CODE	(4) MANUFACTURER'S PART NUMBER	(5) SD STOCK NO.	(6) T/Q
	U5	Integrated Circuit, Quad 2-input NAND GATE, TTL	01295	SN74L03N	045217	1
	U6	Integrated Circuit, Triple 3-input NAND GATE, TTL	01295	SN74L10N	045218	1
	U7	Integrated Circuit, Quad 2-input NAND GATE, TTL	27014	DM74L00N	045267	1
	U8	Integrated Circuit, Quad 2-input NAND GATE, TTL	27014	DM74L00N	045267	1
	U9	Integrated Circuit, Quad 2-input NAND GATE, TTL	27014	DM74L00N	045267	1
	U10	Integrated Circuit, Hex Inverter, TTL	27014	DM74L04N	045268	1
	U11	Integrated Circuit, Dual, 5 k V	50522	MCT6	102858	1
	U12	Integrated Circuit, Dual, 5 k V	50522	MCT6	102858	1
	U13	Integrated Circuit, Dual, 5 k V	50522	MCT6	102858	1
	U14	Integrated Circuit, Dual, 5 k V	50522	MCT6	102858	1
	U15	Integrated Circuit, Quad 2-input EXCLV OR GATE, TTL	01295	SN74L86N	045266	1
	U16	Integrated Circuit, Quad 2-input EXCLV OR GATE, TTL	01295	SN74L86N	045266	1
	U17	Integrated Circuit, Quad D Reg, Tri-State TTL	27014	DM85L51N	045210	1
	U18	Integrated Circuit, Quad D Reg, Tri-State TTL	27014	DM85L51N	045210	1
	U19	Integrated Circuit, Quad D Reg, Tri-State TTL	27014	DM85L51N	045210	1
	U20	Integrated Circuit, Quad D Reg, Tri-State TTL	27014	DM85L51N	045210	1
	U21	Integrated Circuit, Quad D Reg, Tri-State TTL	27014	DM85L51N	045210	1
	U22	Integrated Circuit, Quad D Reg, Tri-State TTL	27014	DM85L51N	045210	1
	U23	Integrated Circuit, Quad D Reg, Tri-State TTL	27014	DM85L51N	045210	1
	U24	Integrated Circuit, Quad D Reg, Tri-State TTL	27014	DM85L51N	045210	1
	U25	Integrated Circuit, Hex Inverter, TTL	27014	DM74L04N	045268	1
	U26	Integrated Circuit, Quad 2-input EXCLV OR GATE, TTL	01295	SN74L86N	045266	1
	U27	Integrated Circuit, Quad 2-input NAND GATE, TTL	27014	DM74L00N	045267	1
	U28	Integrated Circuit, Quad 2-input NAND GATE, TTL	01295	SN74L-3N	045217	1
	U29	Integrated Circuit, 5 Volt Regulator	04713	MC7805CP	045256	1
	U30	Integrated Circuit, Dual, 5 k V	50522	MCT6	102858	1
	U31	Integrated Circuit, Dual, 5 k V	50522	MCT6	102858	1
	U32	Integrated Circuit, Dual, 5 k V	50522	MCT6	102858	1
	U33	Integrated Circuit, Dual, 5 k V	50522	MCT6	102858	1
	W1	Jumper, Molded	- - -	L-2007-1	102879	1
	W2	Jumper, Molded	- - -	L-2007-1	102879	1
	W3	Jumper, Molded	- - -	L-2007-1	102879	1
	W4	Jumper, Molded	- - -	L-2007-1	102879	1
	W5	Jumper, Molded	- - -	L-2007-1	102879	1
	W6	Jumper, Molded	- - -	L-2007-1	102879	1
	W7	Jumper, Molded	- - -	L-2007-1	102879	1
	J1	Connector, 12-pin	71785	252-12-30-160	102650	1

EQUIPMENT/ASSEMBLY DESIGNATION BCD P.C. BOARD ASSEMBLY #03778401 (Cont'd)

(1) DESIGNATOR ITEM	(1) DESIGNATOR REF	(2) COMPONENT NOMENCLATURE AND DESCRIPTION	(3) MFR'S CODE	(4) MANUFACTURER'S PART NUMBER	(5) SD STOCK NO.	(6) T/Q
		Terminal, Swage	88245	2000B	100482	3
		Screw, Pan Head Machine: 4-40 X 3/8	MIL	MS51957-15	10062606	1
		Washer: # 4 flat	MIL	MS15795-803	100703	1
		Washer: #4 split-lock	MIL	MS35338-135	100711	1
		Nut, Hex: 4-40	MIL	NAS671C4	100622	1

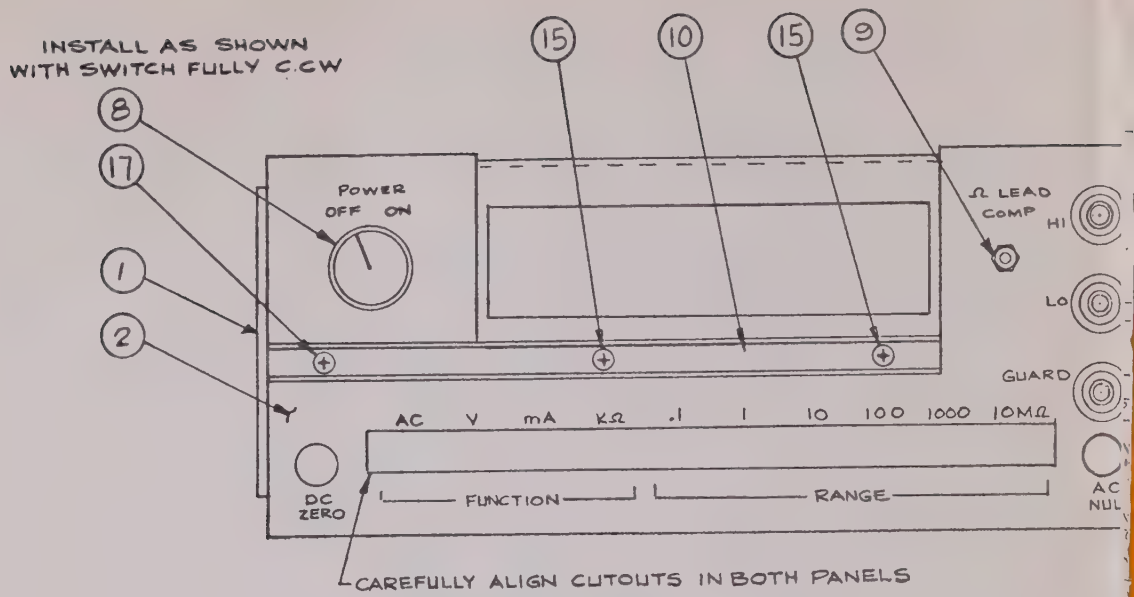

S4-B
S3-B
S2-B
S1-B
S10-B
KΩ
mA
V
AC
DC
TOP
J201
AC POWER
FILTER
F201
1/4A SLO-BLO 115V
1/8A SLO-BLO 230V
S101
POWER
LUG 201
S201
115
230
115
230
LINE
T201
BLK
BLU/BLK
YEL/BLK
GRN/BLK
BRN/BLK
RED/BLK
BLU
BLU/WHT
VIO
BLU/WHT
BLU
RED
RED
GRN
YEL
GRN
BRN
ORN
BRN

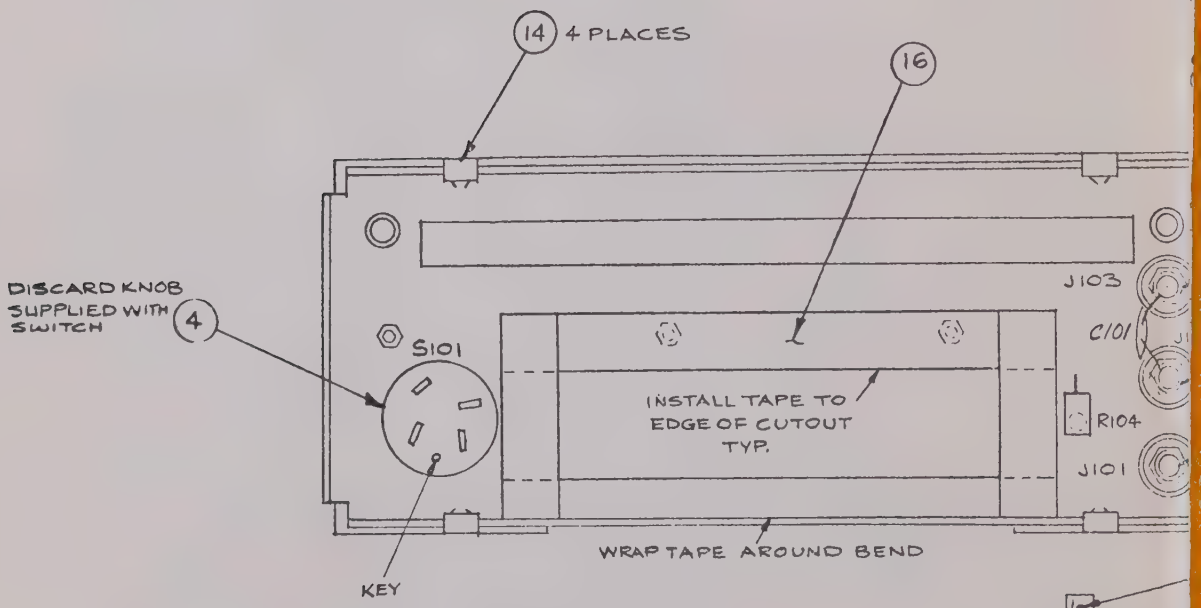
7205-2-74

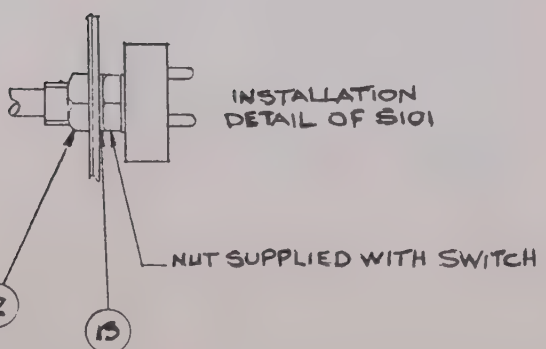


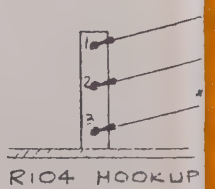
MODEL 7205

BLOCK DIAGRAM #7-03755501 REV A

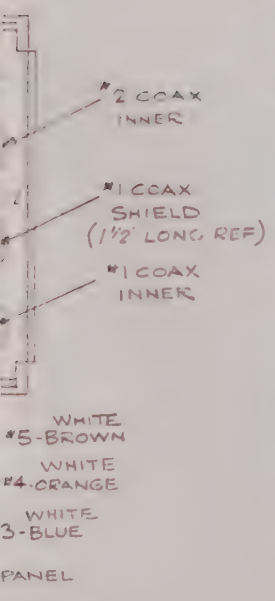

INSTALL AS SHOWN
WITH SWITCH FULLY C.CW
15
10
15
9
8
17
1
2
POWER
OFF ON
Ω LEAD
COMP
HI
LO
GUARD
AC V mA KΩ .1 1 10 100 1000 10MΩ
DC
ZERO
FUNCTION
RANGE
AC
NUL
CAREFULLY ALIGN CUTOUTS IN BOTH PANELS


14 4 PLACES
16
DISCARD KNOB
SUPPLIED WITH
SWITCH
4
S101
J103
C101
INSTALL TAPE TO
EDGE OF CUTOUT
TYP.
R104
J101
WRAP TAPE AROUND BEND
KEY


INSTALLATION
DETAIL OF S101
NUT SUPPLIED WITH SWITCH
12
13

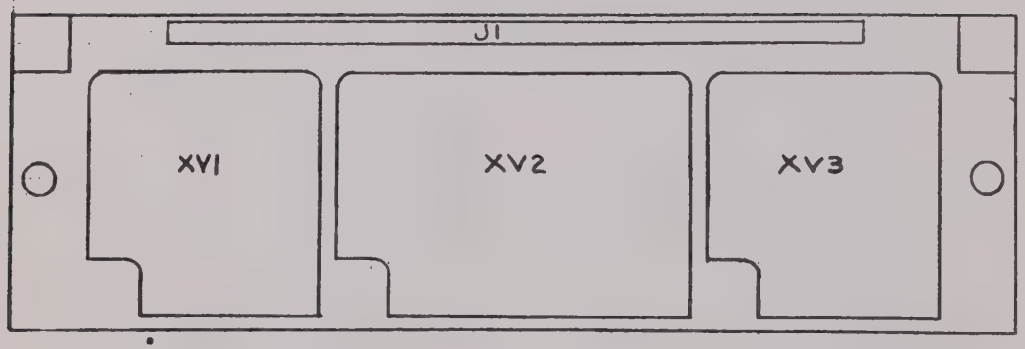

1
2
3
R104 HOOKUP

INSTALLATION OF ITEMS 5, 6 & 7
BEFORE INSTALLATION CLEAN PER MPS 174

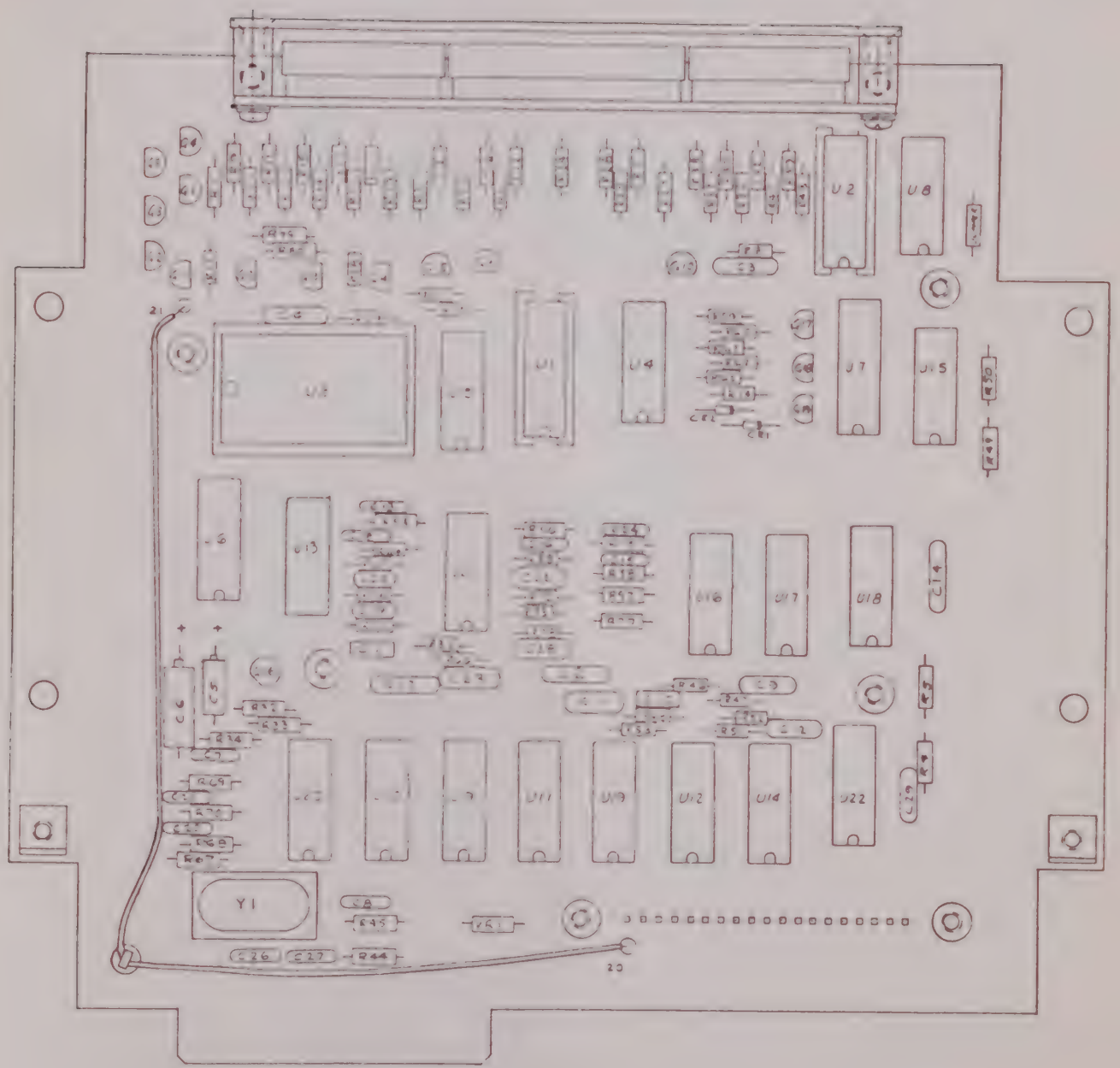


ITEM NO	QTY	PART NUMBER	DESCRIPTION	SCHEMATIC REF NO
16	1	C0221	.005 μfd DISC 1KV	C101
17	1	HD306	SCREW, #2-56 X 3/16", 100° FL HD	
16	A/R	H 38[illegible]	ADHESIVE TAPE 2" WIDE	
15	2	H1[illegible]0	SCREW #[illegible] 100° FL HD	
14	4	H1632	NUT 6-32 TINNERMAN	
13	1	HG507	WASHER 3/8 INT. TOOTH	
12	1	H[illegible]6	NUT HEX 3/8 x 32	
11				
10	1	A037203-1-1	TRIM STRIP	
9	1	R[illegible]5	POT 50K	R104
8	1	H1237	KNOB 1/4 SHAFT	
7	1	101[illegible]1	BINDING POST WHITE	J103
6	1	02[illegible]2	BINDING POST BLACK	J102
5	1	102[illegible]3	BINDING POST RED	J101
4	1	S[illegible]7	SWITCH POWER	S101
3	1	A03[illegible]81	WIRE LIST	
2	1	C037565	FRONT PANEL DECORATIVE	
1	1	C037552	FRONT SUB PANEL	

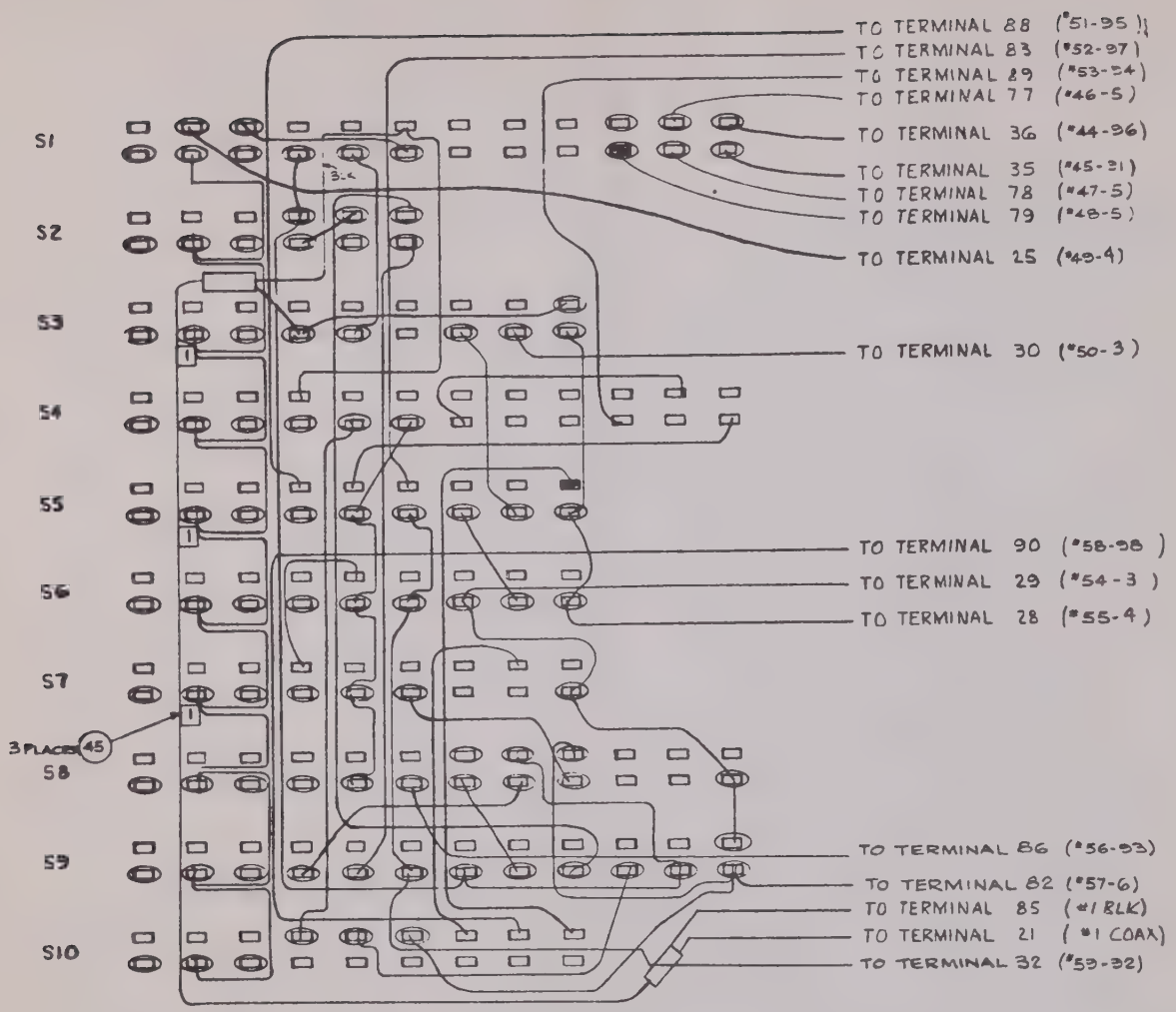
FRONT PANEL
ASSEMBLY #037583 REV B



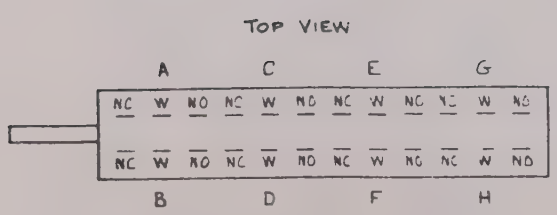
A1, READOUT
ASSEMBLY #03757201 REV A



A2, DIGITAL
ASSEMBLY #03757301 REV B

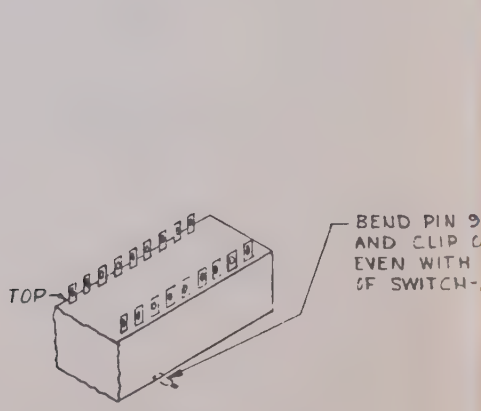


TOP VIEW

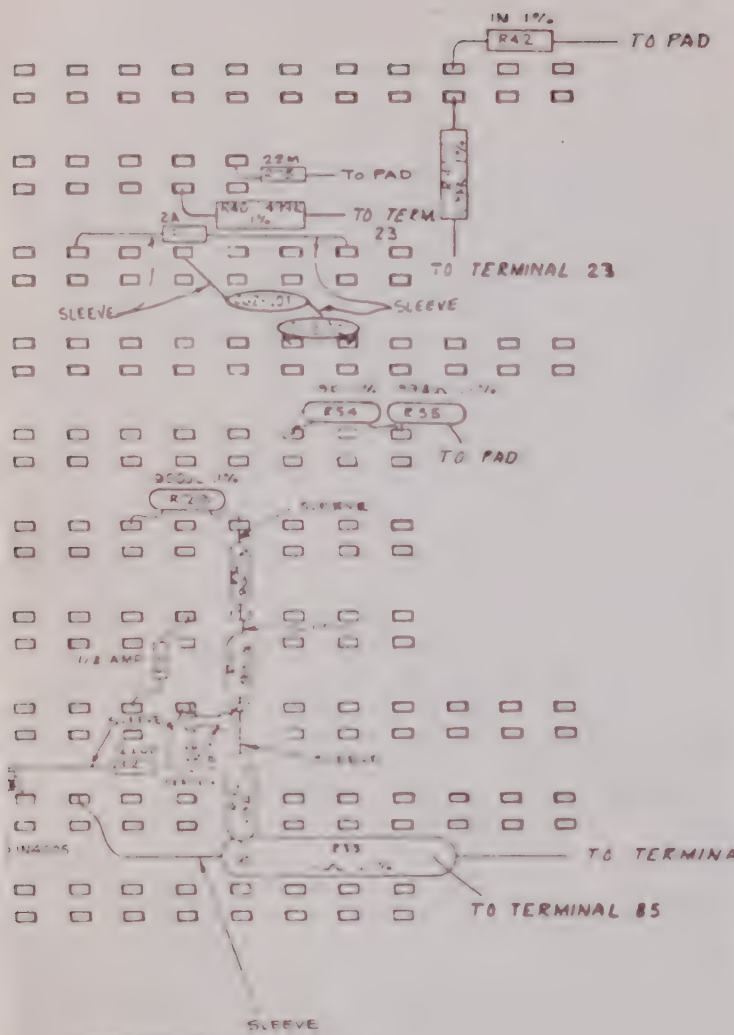


TYPICAL SWITCH CONFIGURATION
NC = NORMALLY CLOSED
W = WIPER
NO = NORMALLY OPEN

DETAIL A

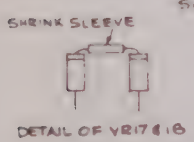


DETAIL B

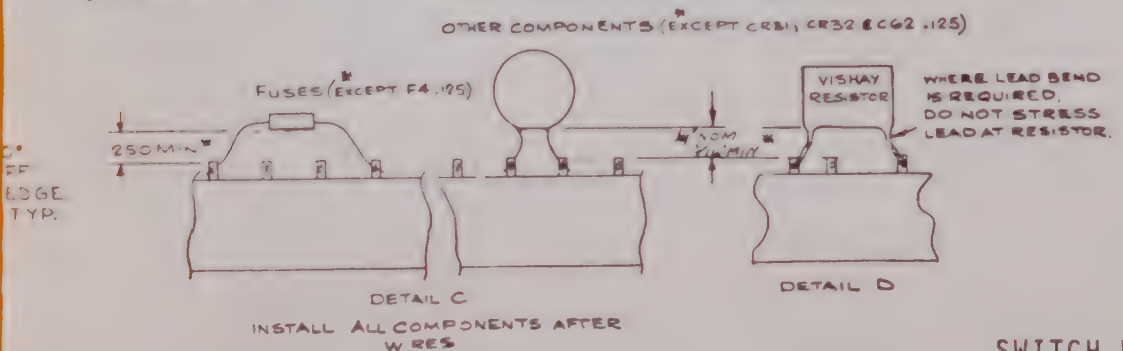


NOTES:

1. ⬭ ON BOTTOM OF SWITCH CLIP OFF THESE PINS PER DETAIL B.
2. ■ DO NOT SOLDER UNTIL COMPONENT HAS BEEN ADDED
3. WIRES TO BE ROUTED EXACTLY AS SHOWN USING WIRE LIST A037574 02, DRESS LEADS WITH MINIMUM SERVICE LOOPS. DO NOT PULL LEADS TIGHT AGAINST SHARP CORNERS OF SWITCH TERMINALS.
4. SLEEVE LEADS AS SHOWN.
5. CLEAN PER MPS 0178



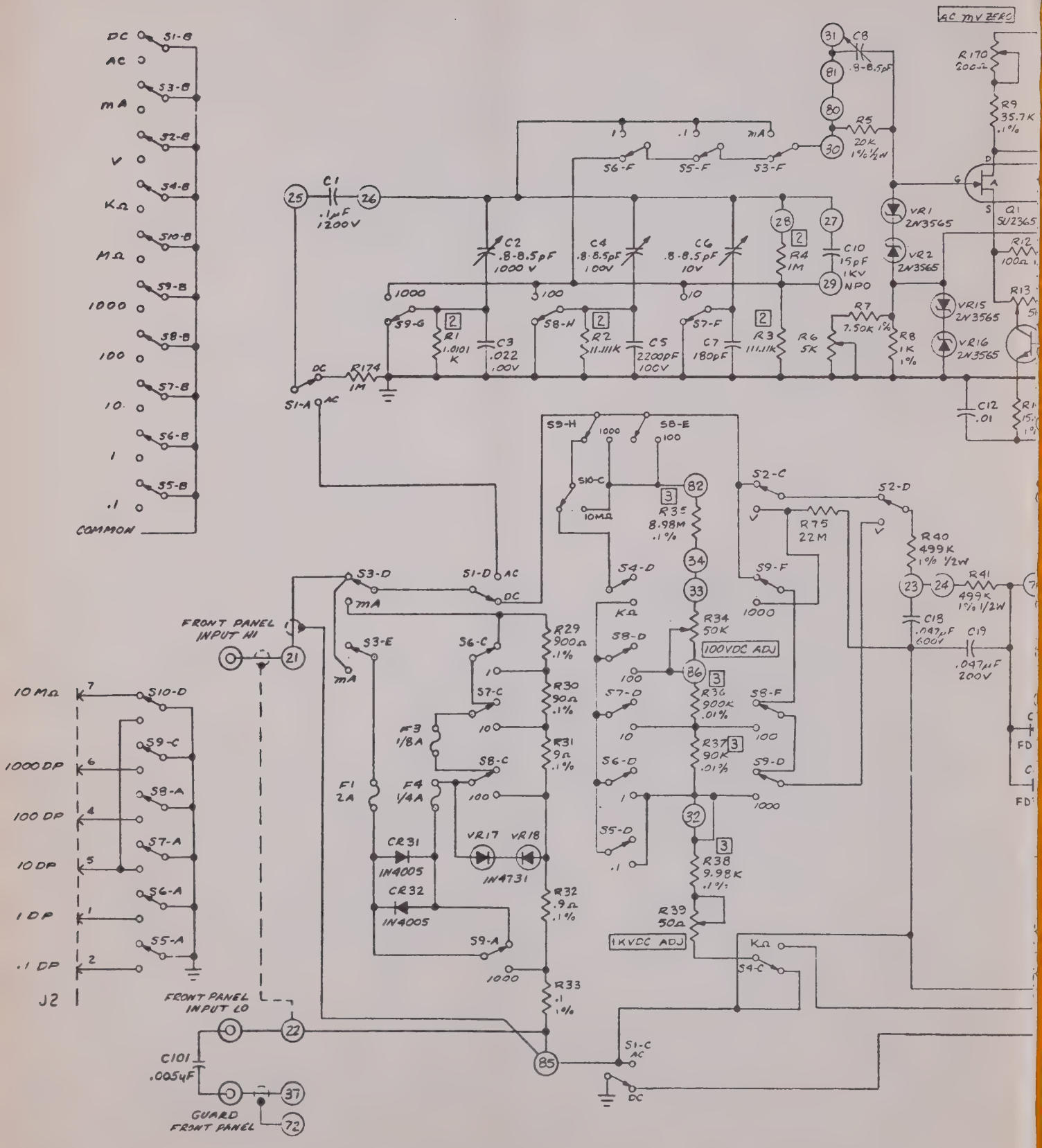
DETAIL OF VR17 & 18

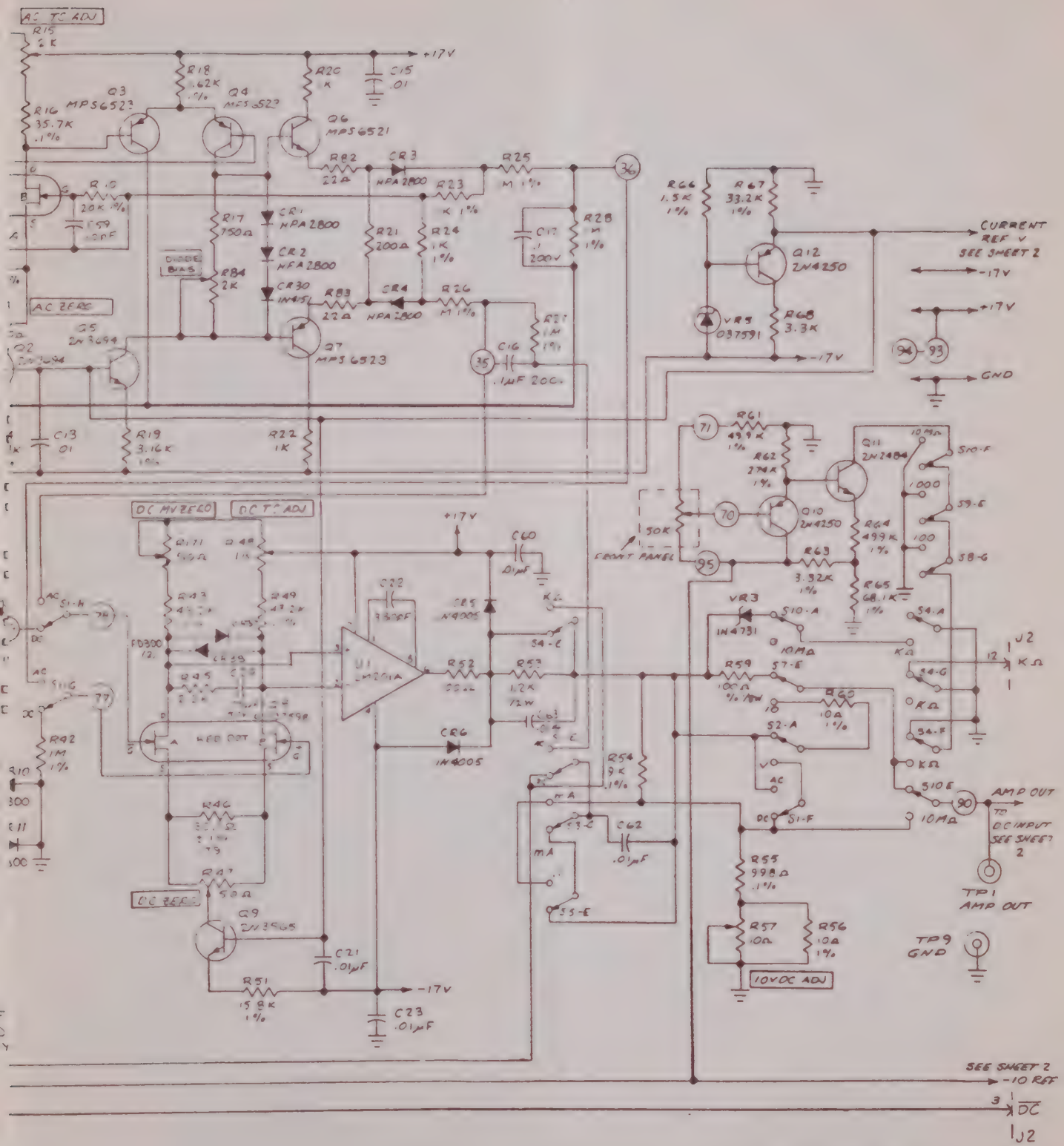

OTHER COMPONENTS (EXCEPT CR31, CR32 & CG2 .125)
FUSES (EXCEPT F4 .125)
250 MIN
.40M MAX
VISHAY RESISTOR
WHERE LEAD BEND IS REQUIRED, DO NOT STRESS LEAD AT RESISTOR.
DETAIL C
DETAIL D

INSTALL ALL COMPONENTS AFTER WIRES

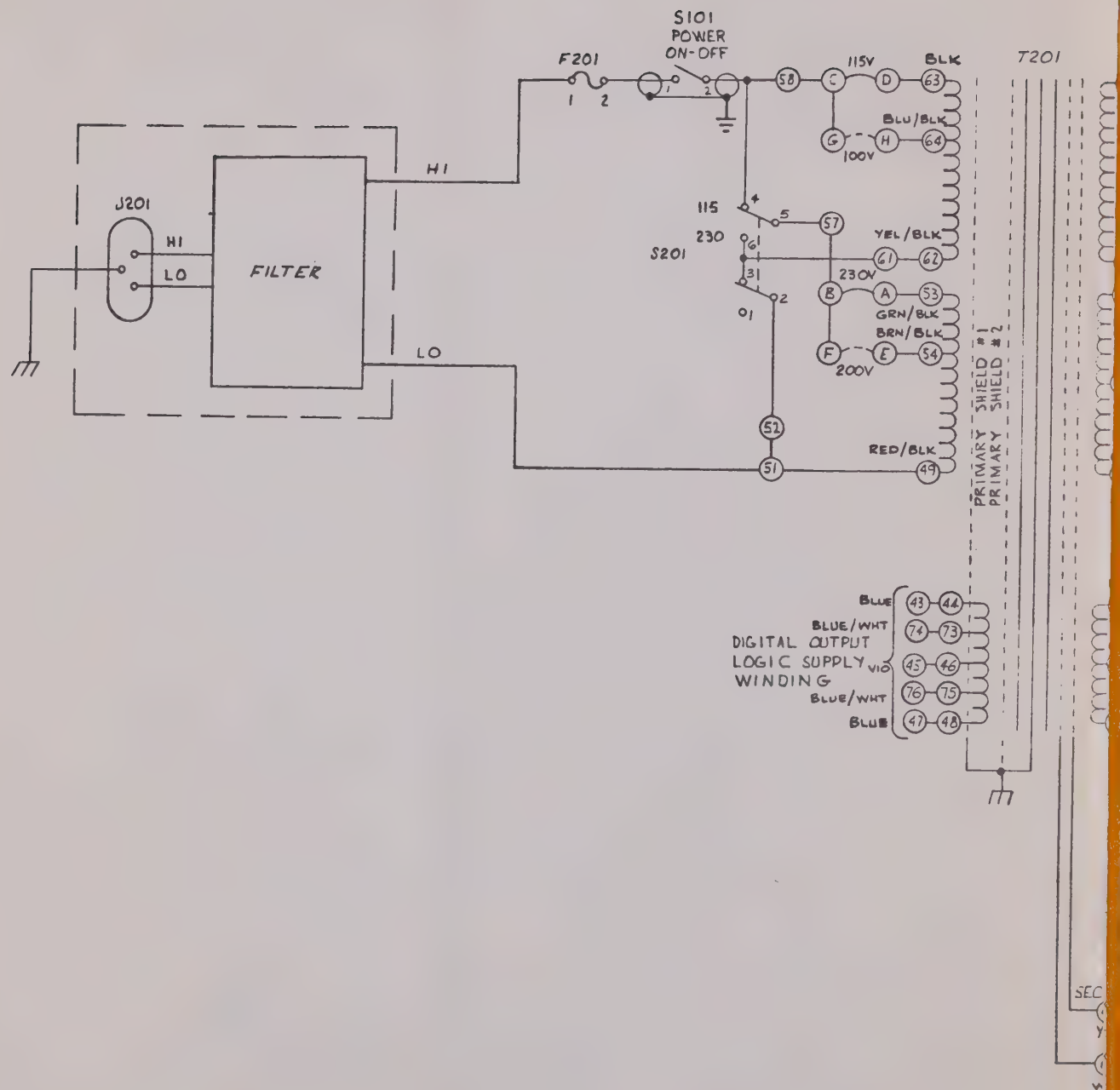
SWITCH WIRING

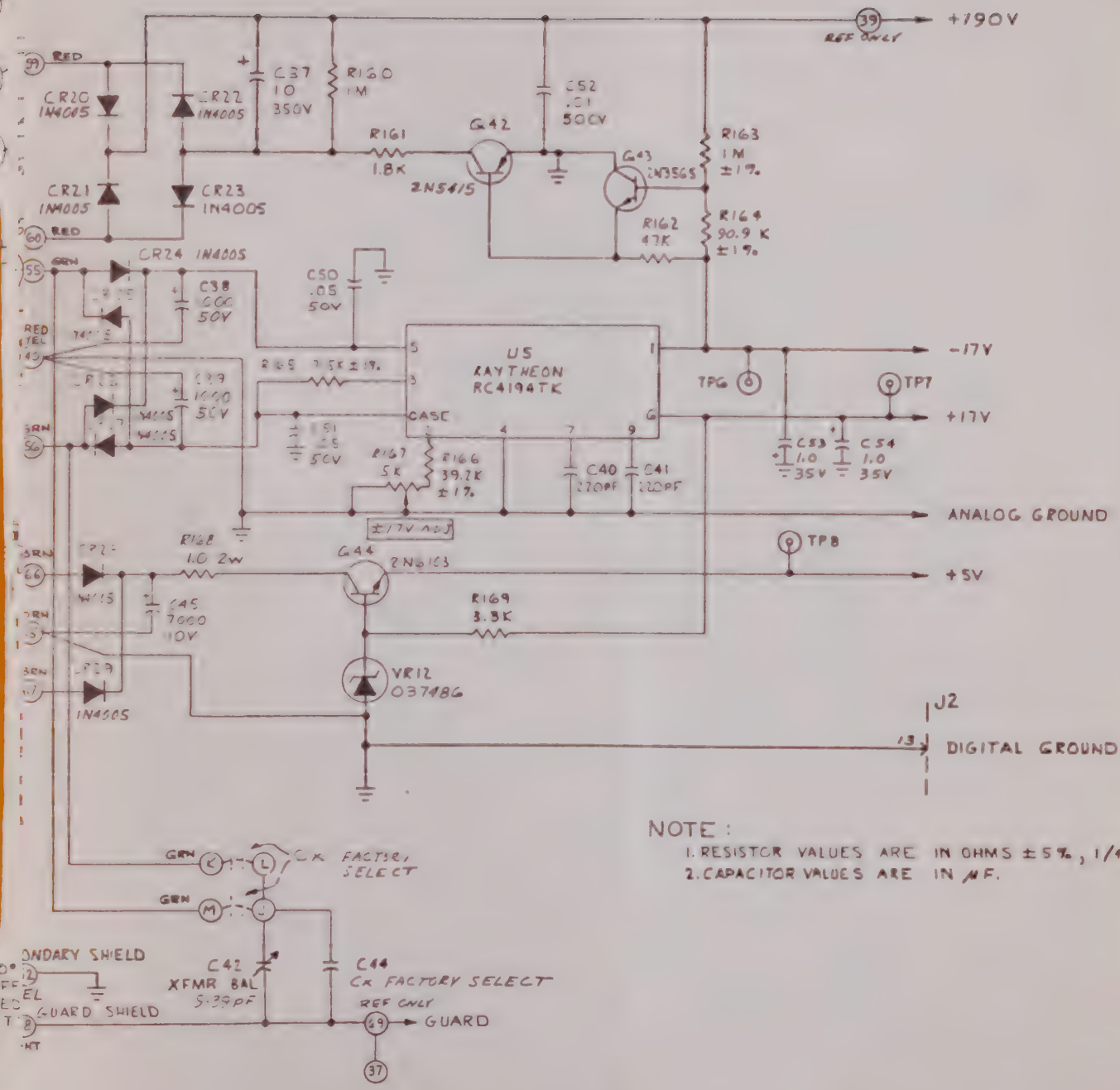
ASSEMBLY #03757493 REV B


DC
AC
mA
V
KΩ
MΩ
1000
100
10
1
.1
COMMON
S1-B
S3-B
S2-B
S4-B
S10-B
S9-B
S8-B
S7-B
S6-B
S5-B
AC mV ZERO
C1
.1μF 1200V
C2 .8-8.5pF 1000 V
C4 .8-8.5pF 100V
C6 .8-8.5pF 10V
C8 .8-8.5pF
C10 15pF 1KV NPO
R1 1.0101 K
R2 11.111K
R3 111.11K
R4 1M
R5 20K 1% 1/2W
R6 5K
R7 7.50K 1%
R8 1K 1%
R9 35.7K .1%
R12 100Ω
R13
R170 200Ω
R174 1M
C3 .022 100V
C5 2200pF 100V
C7 180pF
C12 .01
VR1 2N3565
VR2 2N3565
VR15 2N3565
VR16 2N3565
Q1 SU2365
S1-A
S1-C
S1-D
S2-C
S2-D
S3-D
S3-E
S4-C
S4-D
S5-D
S5-F
S6-C
S6-D
S6-F
S7-C
S7-D
S7-F
S8-C
S8-D
S8-E
S8-F
S8-H
S9-A
S9-C
S9-D
S9-F
S9-H
S10-C
S10-D
10MΩ
R35 8.98M .1%
R75 22M
R40 499K 1% 1/2W
R41 499K 1% 1/2W
C18 .047μF 600V
C19 .047μF 200V
R34 50K
100VDC ADJ
R36 900K .01%
R37 90K .01%
R38 9.98K .1%
R39 50Ω
1KVDC ADJ
R29 900Ω .1%
R30 90Ω .1%
R31 9Ω .1%
R32 .9Ω .1%
R33 .1 .1%
F1 2A
F3 1/8A
F4 1/4A
CR31 IN4005
CR32 IN4005
VR17 VR18 IN4731
FRONT PANEL INPUT HI
FRONT PANEL INPUT LO
GUARD FRONT PANEL
C101 .005μF
10 MΩ
1000 DP
100 DP
10 DP
1 DP
.1 DP
J2
S10-D
S9-C
S8-A
S7-A
S6-A
S5-A



A3, ANALOG
SCHEMATIC #7-03757401 REV B
(Sheet 1 of 3)

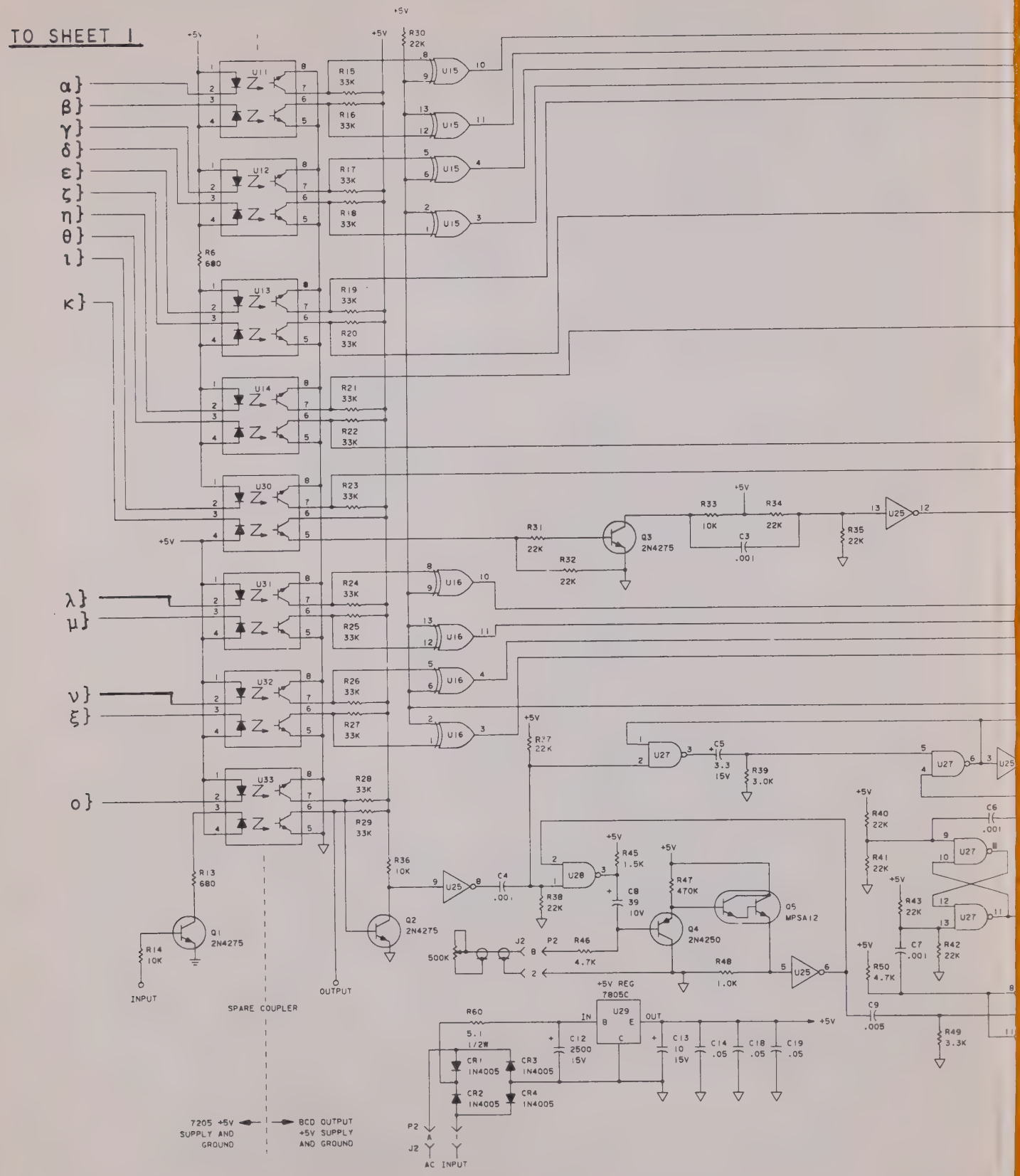

S101
POWER
ON-OFF
F201
1
2
115V
BLK
T201
58
C
D
63
BLU/BLK
G
H
64
100V
J201
HI
LO
FILTER
HI
LO
115
230
S201
4
5
6
1
3
1
2
0
1
57
YEL/BLK
61
62
230V
B
A
53
GRN/BLK
BRN/BLK
F
E
54
200V
52
51
RED/BLK
49
PRIMARY SHIELD #1
PRIMARY SHIELD #2
BLUE
43
44
BLUE/WHT
74
73
DIGITAL OUTPUT
LOGIC SUPPLY
WINDING
VIO
45
46
BLUE/WHT
76
75
BLUE
47
48
SEC

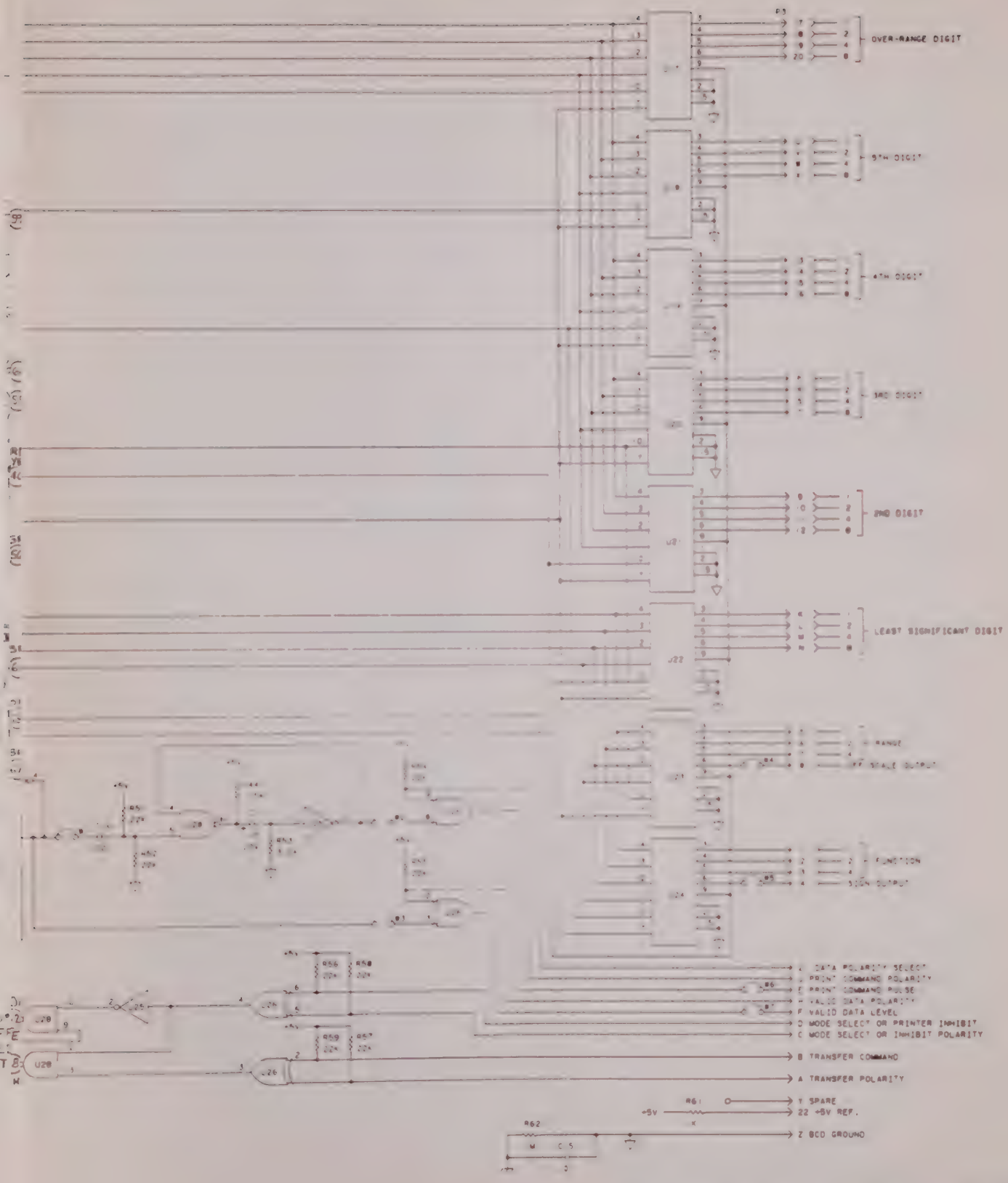


NOTE :

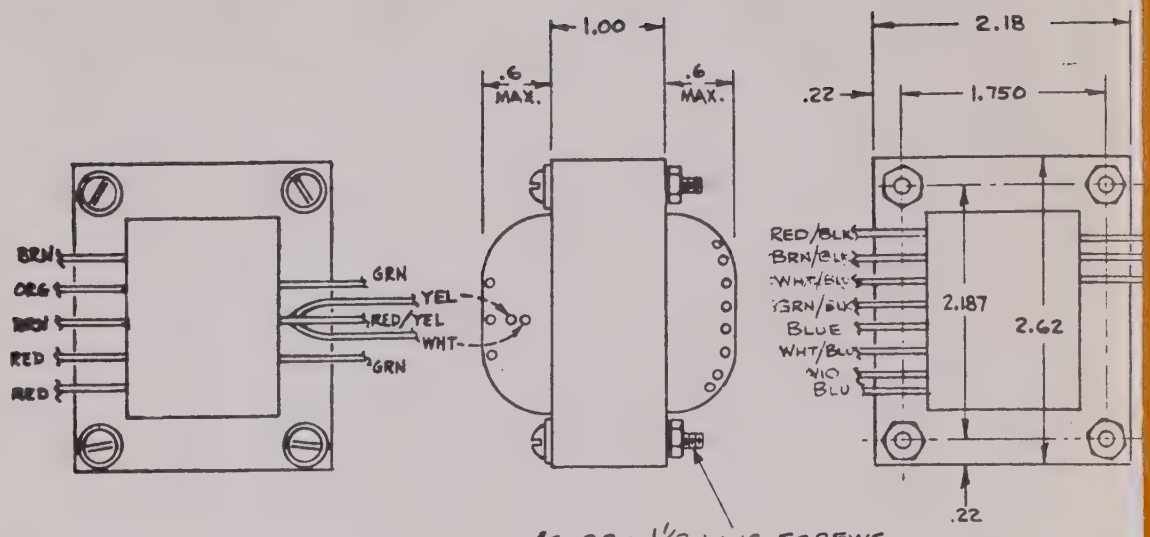
1. RESISTOR VALUES ARE IN OHMS ±5%, 1/4W.
2. CAPACITOR VALUES ARE IN μF.

A3, ANALOG
SCHEMATIC #7-03757401 REV B
(Sheet 3 of 3)


TO SHEET 1
α}
β}
γ}
δ}
ε}
ζ}
η}
θ}
ι}
κ}
λ}
μ}
ν}
ξ}
ο}
+5V
R6 680
R13 680
R14 10K
R15 33K
R16 33K
R17 33K
R18 33K
R19 33K
R20 33K
R21 33K
R22 33K
R23 33K
R24 33K
R25 33K
R26 33K
R27 33K
R28 33K
R29 33K
R30 22K
R31 22K
R32 22K
R33 10K
R34 22K
R35 22K
R36 10K
R37 22K
R38 22K
R39 3.0K
R40 22K
R41 22K
R42 22K
R43 22K
R45 1.5K
R46 4.7K
R47 470K
R48 1.0K
R49 3.3K
R50 4.7K
R60 5.1 1/2W
C3 .001
C4 .001
C5 3.3 15V
C6 .001
C7 .001
C8 39 10V
C9 .005
C12 2500 15V
C13 10 15V
C14 .05
C18 .05
C19 .05
U11
U12
U13
U14
U15
U16
U25
U27
U28
U29
U30
U31
U32
U33
Q1 2N4275
Q2 2N4275
Q3 2N4275
Q4 2N4250
Q5 MPSA12
500K
J2
P2
INPUT
OUTPUT
SPARE COUPLER
+5V REG 7805C
IN
OUT
CR1 1N4005
CR2 1N4005
CR3 1N4005
CR4 1N4005
7205 +5V SUPPLY AND GROUND
BCD OUTPUT +5V SUPPLY AND GROUND
AC INPUT

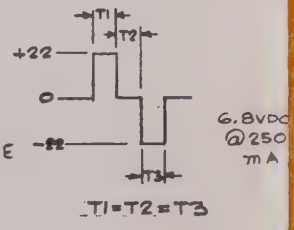


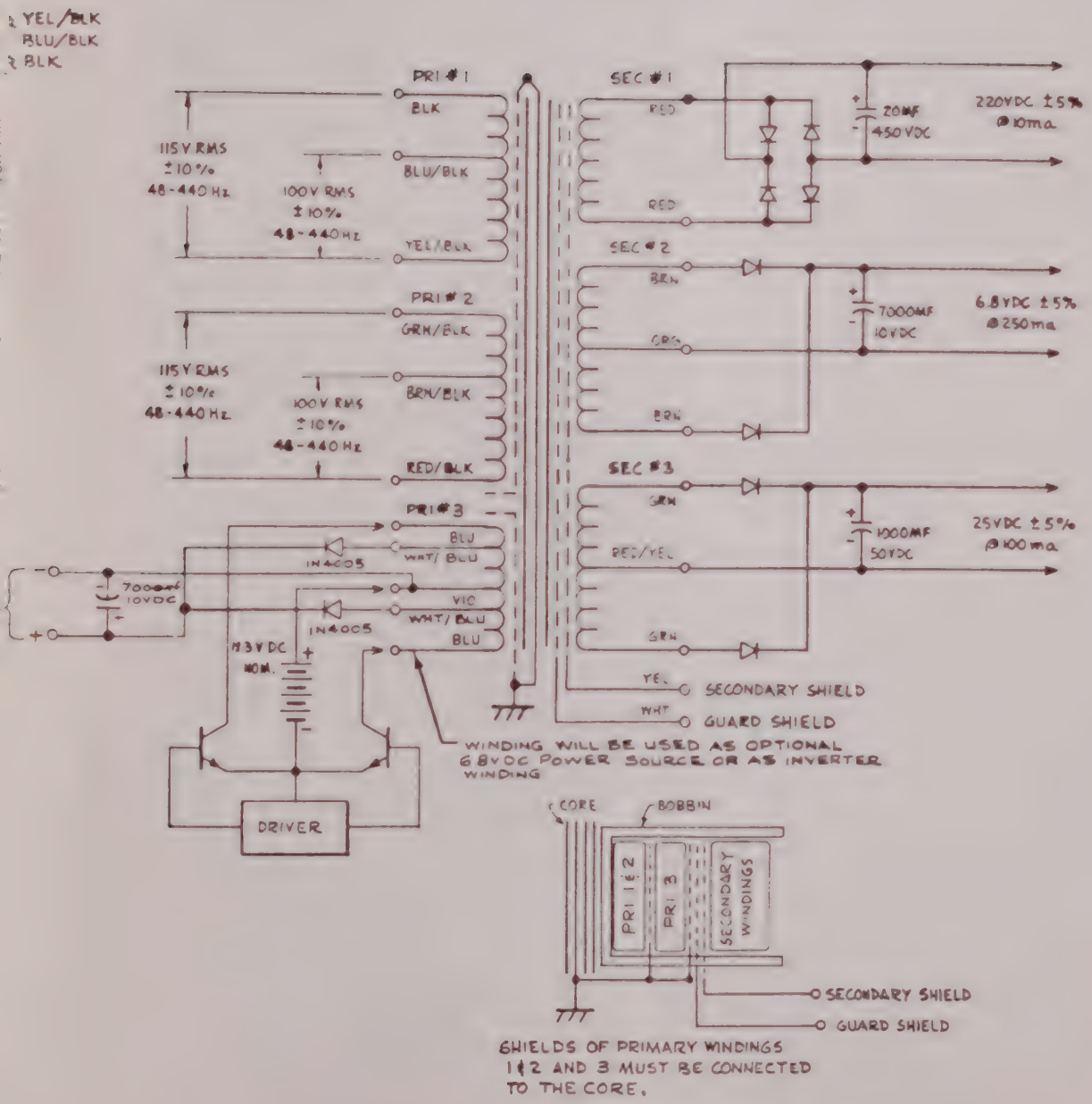
OPTION 05, DIGITAL OUTPUTS
SCHEMATIC #7-03778401
(Sheet 2 of 2)



#6-32 x 1½ LONG SCREWS
& #6-32 HARDWARE TO BE SUPPLIED BY VENDOR.
THREADS TO BE FREE OF EPOXY

1. PRIMARY WINDINGS CONNECT IN PARALLEL FOR 115V RMS OR 100V RMS OPERATION.
2. PRIMARY WINDINGS CONNECT IN SERIES FOR 230V RMS OR 200V RMS OPERATION.
3. DC OUTPUT VOLTAGE TOLERANCE SPECIFIED WITH 115VRMS 48-440 Hz LINE, OR 44V PEAK TO PEAK RECTANGULAR DRIVE.
4. MAXIMUM ALLOWABLE TEMPERATURE RISE IS 40°C.
5. OPERATING AMBIENT TEMPERATURE RANGE IS 0 TO +65°C.
6. ALL LEAD LENGTHS - 12 INCHES MINIMUM. TEFLON INSULATED AND COLOR CODED AS SHOWN.
7. SECONDARY WINDINGS TO SHIELDS, OR SHIELD TO SHIELD BREAKDOWN VOLTAGE SHALL EXCEED 1 KV RMS, 60Hz.
8. VACUUM IMPREGNATE WITH EPOXY.
9. ALL RECTIFIERS SHOWN ARE IN4005 (1 AMP SILICON).
10. ALL LEADS WILL BE BROUGHT OUT AS SHOWN.
11. TRANSFORMER TO BE MARKED WITH "SD 037589 , REV. _ " (LATEST REV.).





TRANSFORMER, SPEC. #037569

3814

DIGITAL VOLTMETER LOGIC ARRAY

FAIRCHILD SILICON GATE MOS INTEGRATED CIRCUIT

GENERAL DESCRIPTION — The 3814 provides the logic required to implement a 4 1/2-Decade Digital Voltmeter. In addition to four full decade counters and two overflow latches, the device is designed to drive a multiplexed display providing a Binary Coded Decimal output (to drive a BCD converter) and five decoded outputs to strobe the display.

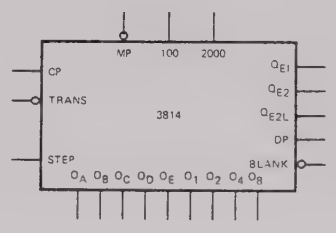
Automatic leading zero blanking is simply accomplished, and a separate input is provided to blank the entire display. Other outputs provide counter overflow information and auto-ranging control signals. The 3814 is manufactured using silicon gate P-channel enhancement mode technology.

- **DIRECT TTL/DTL COMPATIBILITY — NO EXTERNAL COMPONENTS**
- **DC TO 600 kHz OPERATION**
- **BCD OUTPUT — COMPATIBLE WITH DISPLAY DECODERS**
- **EXTERNAL CONTROL MULTIPLEX FREQUENCY — ACCOMMODATES LED DISPLAYS**
- **UNDER RANGE AND OVER RANGE OUTPUTS**
- **10-COUNT DELAY TO MASK ANALOG SWITCHING NOISE**

ABSOLUTE MAXIMUM RATINGS

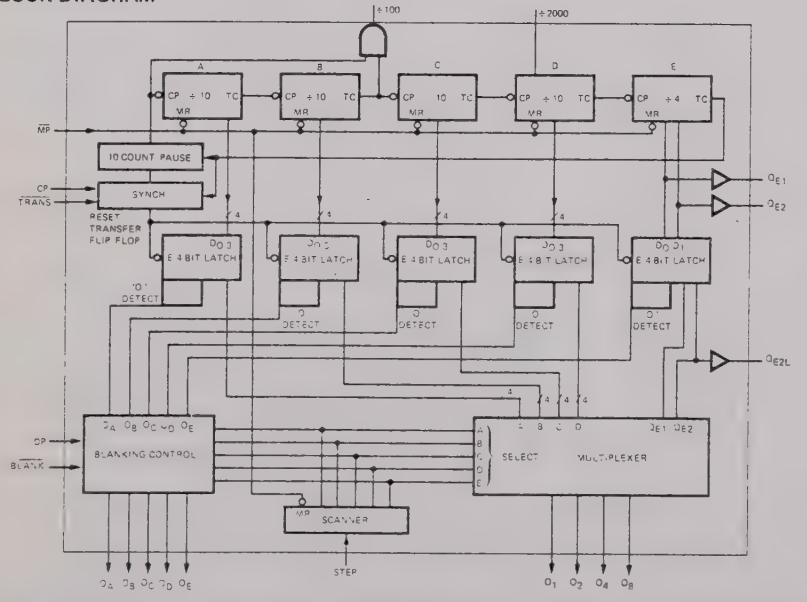
Storage Temperature	-65°C to +150°C
Operating Temperature	0°C to 70°C
V_{GG}	+0.3 to -24V
All Other Inputs	+0.3 to -16V
Outputs	+0.3 to -8V (I_L < 10 mA)

LOGIC SYMBOL

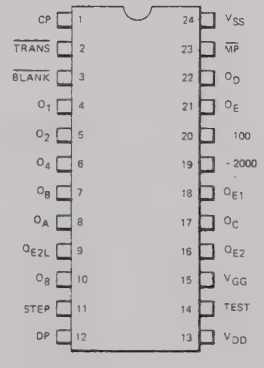


V_{SS} = PIN 24
V_{GG} = PIN 15
V_{DD} = PIN 13

BLOCK DIAGRAM



CONNECTION DIAGRAM
(TOP VIEW)



Fairchild makes no representation that the 3814 can be used in the circuits described herein without infringing the patents of third parties. The sale of the 3814 by Fairchild conveys no rights by implication, estoppel or otherwise, under patent claims covering combinations of this product with other devices or elements.

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Catalog with permission 15 OCT 73.

FUNCTIONAL DESCRIPTION: The 3814 is intended for use as the digital logic portion of digital voltmeter systems. An input clock (CP) drives 4-1/2 decades of BCD counters, with the counters changing state on the LOW to HIGH clock transition. The output of the second decade is gated with the input clock (CP) and brought off chip (÷100) for use as an additional clock. This clock may be used to drive the multiplexer input (Step).

A clock input following a LOW state on Master Preset ($\overline{MP}$) will set the counters to 30,000. The 3814 will then count the next 10,000 clock pulses, and be in the 00,000 state. At this count the device will ignore the next 10 clock inputs. This feature is useful when the device is used in systems where the current switching associated with analog to digital conversion generates transients which might cause false triggering. This 10 count correction requires a small current (equal to the integral of 10 counts of the standard current) be added to the unknown current. Thus, even if the current to be measured is zero, the integrator output voltage is moved off zero, eliminating comparator transient triggering. Following this 10 count pause, the 3814 continues to count. In normal operation the A-D circuitry will provide a transfer input, causing the count to be loaded into the latches. The count stored (and present at the output multiplexer) will be proportional to the ratio of the unknown current to the standard current. The counter will continue to accept clock pulses, and at 20,000 the Q_{E1} output will go LOW and the Q_{E2} output will go HIGH. This state may be decoded and used to reset the analog circuitry. Since current switching associated with this reset may again cause false triggering, only one transfer command is accepted during the interval from 00,000 to 39,000.

In typical operation, the states of the two overflow flip-flops (Q_{E1} and Q_{E2}) may be used to control system operation.

COUNT	Q_{E1}	Q_{E2}
30,000 to 00,000	1	1
00,000 to 10,000	0	0
10,000 to 20,000	1	0
20,000 to 30,000	0	1

In addition, the Q_{E2} output is latched and brought out as Q_{E2L}. If a system utilizing a full-scale count of 19,999 is implemented with the 3814, the HIGH state of Q_{E2L} will indicate an over-range condition. The divide by 2,000 output (÷2,000) is intended for use as an under-range indicator. If this output has not gone HIGH when a transfer command is received, the total count is less than 10% of full scale.

DATA OUTPUTS – The state of one of the 4 1/2 decade counters is presented as a BCD multiplexed output (O_1, O_2, O_4, O_8). One of the five decoded outputs (O_A, O_B, O_C, O_D, O_E) will be HIGH, indicating which decade's count is present at the BCD outputs. The multiplexer is clocked by a separate input (Step) which may be driven at 1/100 of the clock frequency by directly connecting the ÷100 output to the Step input.

BLANKING – Automatic leading zero blanking is simply accomplished by directly wiring two pins of the 3814. One of the decade outputs (O_A through O_E) when wired to the decimal point (DP) input will cause all leading zeros to the left of the feedback decade to be automatically blanked. For example if the count is 00120 and decade "A" (O_A) is connected to DP, the display will be "120". With the same count, and decade "D" (O_D) connected to DP, the display will be 0120. When the $\overline{Blank}$ input is LOW all outputs (O_A thru O_E) go LOW.

TEST INPUT – This pin is used during the testing of the 3814 and must be wired to V_{SS} for operation.

DC CHARACTERISTICS: V_{SS} = +5.0 V ±5%, V_{DD} = 0 V, V_{GG} = −12 V ±5%, T_A = 0°C to +70°C

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX.	UNITS	CONDITIONS
V_{IH}	Input Voltage HIGH	V_{SS}−1.0		V_{SS}+0.3	V	All Inputs Including CP
V_{IL}	Input Voltage LOW	−2		+0.8	V	All Inputs Including CP
V_{OH1}	Output Voltage HIGH	2.4		V_{SS}	V	a) Sourcing 200 µA for Outputs. Q_{E1}, Q_{E2}, Q_{E2L}, ÷2000, C_L <20 pF. b) Sourcing 400 µA for outputs: O_1, O_2, O_4, O_8; C_L <30 pF.
V_{OH2}	Output Voltage HIGH	V_{SS}−1.0		V_{SS}	V	Sourcing 200 µA for outputs O_A, O_B, O_C, O_D, O_E, ÷100; C_L <20 pF
V_{OL}	Output Voltage LOW			0.4	V	a) Sink 1.6 mA on outputs Q_{E1}, Q_{E2}, Q_{E2L}, O_A, O_B, O_C, O_D, O_E, ÷100, ÷2000; C_L <20 pF. b) Sink 2.0 mA on outputs O_1, O_2, O_4, O_8, C_L <30 pF.
R_{IN1}	Input Resistor Returned to V_{SS}	1	2.5	5	kΩ	Inputs: CP, $\overline{Blank}$, $\overline{MP}$, $\overline{Trans.}$
R_{IN2}	Input Resistor Returned to V_{SS}	10	25	50	kΩ	Inputs: Step, DP
I_{GG}	V_{GG} Supply Current	3	5	15	mA	
I_{SS}	V_{SS} Supply Current	20	30	50	mA	

AC CHARACTERISTICS: V_{SS} = +5.0 V ±5%, V_{DD} = 0 V, V_{GG} = −12 V ±5%, T_A = 0°C to 70°C.

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	COMMENTS
f	Operating Frequency	DC		1.667	μs	Figure 1
$t_{PW\phi}$	Clock Pulse Width	300	220		ns	Figure 1
t_{TS}	TRANS Set Up Time	250			ns	Figure 2
t_{TH}	TRANS Hold Time	50			ns	Figure 2
t_{DHL}	HIGH to LOW Transistion for Outputs					
	÷100		320	1000	ns	Figure 3
	÷2000		375	1000	ns	Figure 3
	Q_{E1}, Q_{E2}		400	800	ns	Figure 3
	O_1, O_2, O_4, O_8		450	1000	ns	Figure 4
t_{DLH}	LOW to HIGH Transition for Outputs					
	÷100,		350	1000	ns	Figure 3
	÷2000,		450	1000	ns	Figure 3
	Q_{E1}, Q_{E2}		425	800	ns	Figure 3
	O_1, O_2, O_4, O_8		550	1000	ns	Figure 4
t_{PDC}	Clock		60	200	ns	Figure 1

TIMING DIAGRAMS

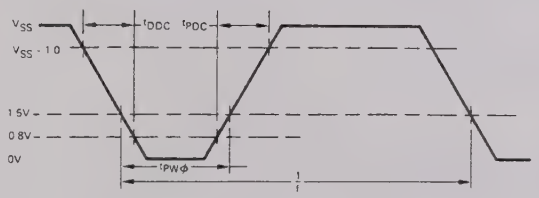


Fig. 1. Input clock waveform

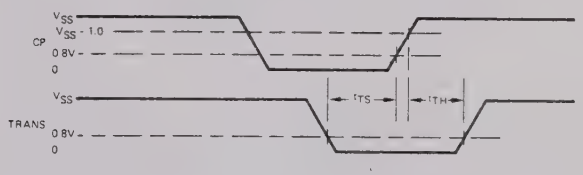


Fig. 2. Transfer setup and hold times

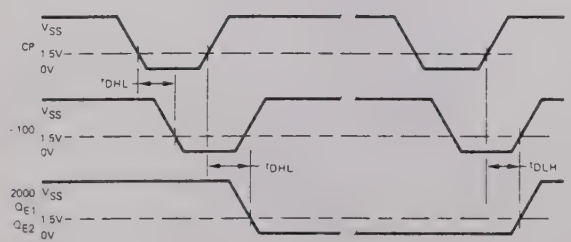


Fig. 3. Propagation delay-outputs

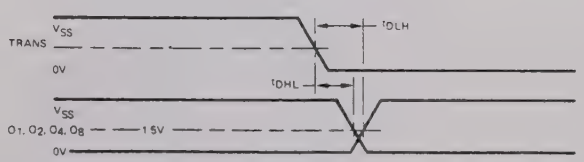
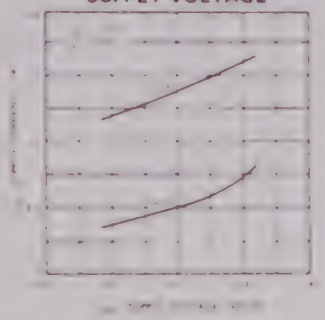


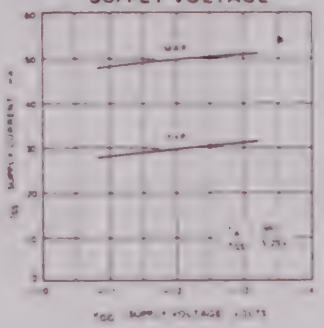
Fig. 4. Propagation delay - BCD outputs

ELECTRICAL CHARACTERISTICS

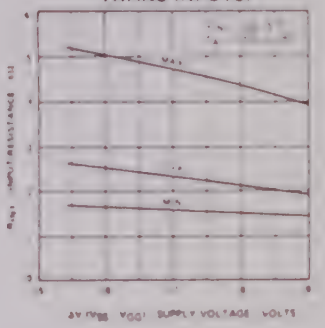
SUPPLY CURRENT VERSUS SUPPLY VOLTAGE



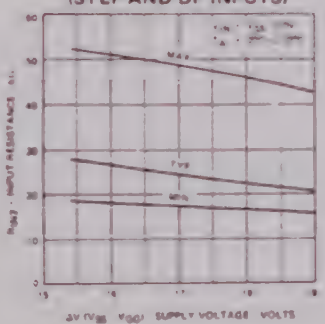
SUPPLY CURRENT VERSUS SUPPLY VOLTAGE



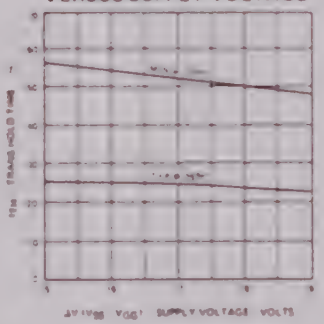
INPUT RESISTANCE VERSUS SUPPLY VOLTAGE (CP, $\overline{\text{BLANK}}$, $\overline{\text{MP}}$ AND $\overline{\text{TRANS}}$ INPUTS)



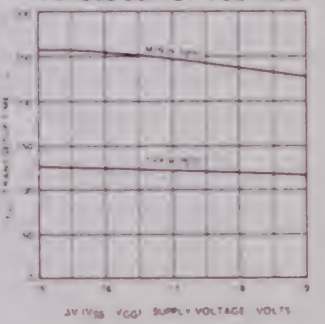
INPUT RESISTANCE VERSUS SUPPLY VOLTAGE (STEP AND DP INPUTS)



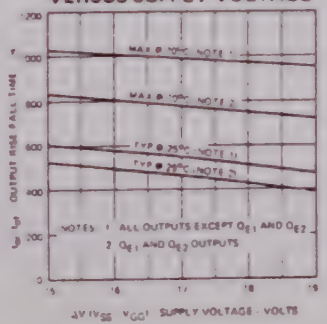
TRANSFER HOLD TIME VERSUS SUPPLY VOLTAGE



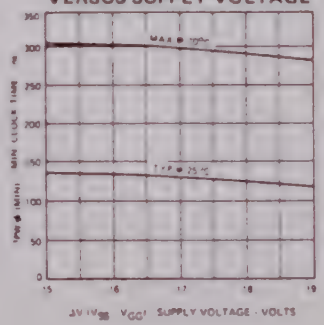
TRANSFER SET-UP-TIME VERSUS SUPPLY VOLTAGE



OUTPUT RISE/FALL TIME VERSUS SUPPLY VOLTAGE



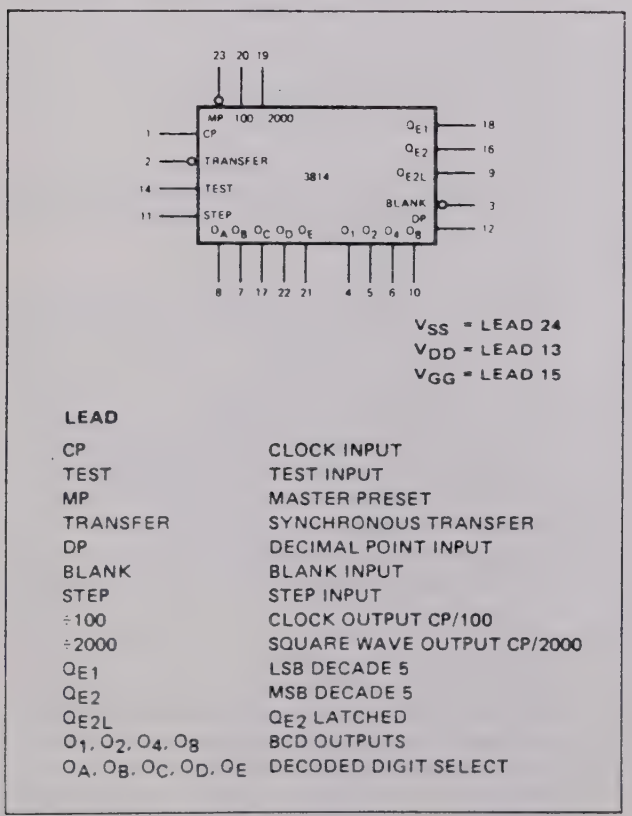
MINIMUM CLOCK TIME VERSUS SUPPLY VOLTAGE



THE 3814 DIGITAL VOLTMETER LOGIC ARRAY

INTRODUCTION

Fairchild Semiconductor has developed a silicon gate device that contains most of the logic required for a 4 1/2 decade digital voltmeter. All necessary BCD counters, latches and the display multiplexing logic is on chip. In addition, the control signals necessary for dual slope integration techniques are generated by the 3814 device. The BCD outputs can directly drive a 9315 BCD to 1-of-10 decoder or 9307 BCD to 7-segment decoder. Zero suppression is generated on chip by feeding back the DIGIT SELECT output. Outputs are also provided for indicating over range and under range. A unique feature of the 3814 is the incorporation of a 10-count pause at the start of an integration cycle to mask noise generated when switching the external analog circuits, such as the reference current source.



LEAD	
CP	CLOCK INPUT
TEST	TEST INPUT
MP	MASTER PRESET
TRANSFER	SYNCHRONOUS TRANSFER
DP	DECIMAL POINT INPUT
BLANK	BLANK INPUT
STEP	STEP INPUT
÷100	CLOCK OUTPUT CP/100
÷2000	SQUARE WAVE OUTPUT CP/2000
Q_{E1}	LSB DECADE 5
Q_{E2}	MSB DECADE 5
Q_{E2L}	Q_{E2} LATCHED
O_1, O_2, O_4, O_8	BCD OUTPUTS
O_A, O_B, O_C, O_D, O_E	DECODED DIGIT SELECT

Fig. 1. Logic symbol and lead designation.

DUAL SLOPE INTEGRATION

A reliable and accurate DVM circuit must be insensitive to long term changes of such factors as supply voltage, time base, and passive and active component values. For the short term, it must be able to reject 60 Hz line perturbations. Dual Slope Integration achieves a high degree of accuracy by causing the effect of changes in these parameters to cancel.

One method of Dual Slope Integration involves integrating a current directly related to the unknown voltage (V_X) for a fixed period of time, followed by the integration of a standard current (I_S) until the integrator output returns to zero. The amount of time required to null the integrator is directly proportional to the ratio of I_X to I_S and therefore to V_X. Since the same system power supply, time base and components are used for integrating the known and unknown currents, their absolute values are not extremely critical.

3814 BLOCK DIAGRAM

The 3814 provides 4 1/2 decades of BCD counters, with a modulus of 40,000, clocked by the CP input, (Figure 2). The CP input is TTL compatible and requires a low time of 300 ns minimum and a high time of 500 ns minimum. The counters change state on the low-to-high CP transition.

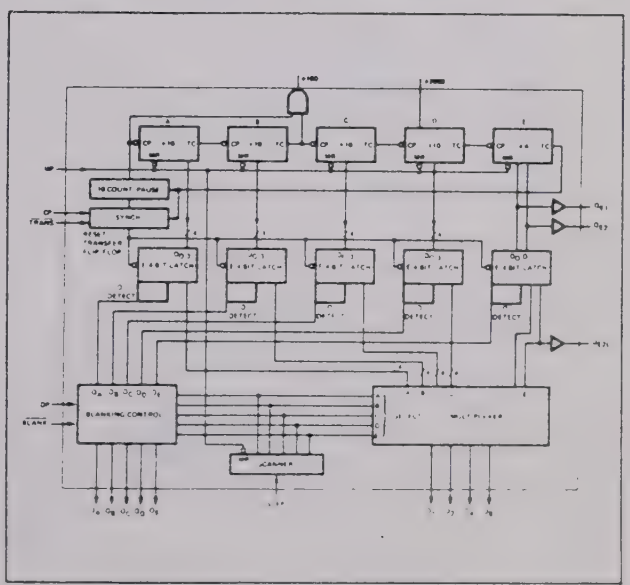


Fig. 2. Block diagram.

Fairchild makes no representation that the 3814 can be used in the circuits described herein without infringing the patents of third parties. The sale of the 3814 by Fairchild conveys no rights by implication, estoppel or otherwise, under patent claims covering combinations of this product with other devices or elements.

The second decade output is gated with the clock and brought off chip to provide a clock pulse output for every 100 input clocks ("÷100 output"). The output of the first flip-flop of the thousands decade is buffered and brought directly off chip as "÷2000". The outputs of both flip-flops of the fifth "half decade" are available as outputs Q_{E1} and Q_{E2}. The latched state of the most significant bit (Q_{E2L}) is also brought off chip.

A TRANSFER input causes the data in the counters to be stored in the latches. This input is edge sensitive and is synchronized internally with the clock. When the TRANSFER input changes from high to low the circuit is enabled, so that when CP goes low, data is stored. A TRANSFER command is permitted only once during a count cycle by an internal flip-flop which is set when the first transfer occurs, and remains set until the next terminal count (counters advancing from 39,999 to 00,000). Transfers are ignored when this flip-flop is set.

The latched state of each decade is multiplexed out as BCD data on outputs O_1, O_2, O_4 and O_8. The multiplexer is driven by a scanner counter with outputs O_A, O_B, O_C, O_D and O_E available. This counter is clocked by the STEP input causing the stored data to appear, decade by decade, on the O_1, O_2, O_4 and O_8 outputs. One of the O_A through O_E outputs will be high indicating the decade displayed. The BLANK input (active low) causes all five of these outputs to go low. Because outputs O_A through O_E can drive display lamps in a multiplexed system the display will blank when they are low.

FUNCTIONAL DESCRIPTION

Figure 3 is a simplied schematic of a digital voltmeter using a 3814 with an integrator and comparator front-end. Figure 4 shows the output waveforms of the integrator and comparator for a typical cycle when some unknown voltage is applied to the input of the integrator (V_x). During the time interval from 30,000 to 39,999, a current I_x ($\approx V_x/R_x$) is integrated. When the counter reaches 40,000 (or 00,000), the input to the integrator is switched to integrate the standard current I_s. Integration of the standard current continues until the integrator crosses the null point. At this time, the comparator output switches states to a LOW and this signal is used to cause a transfer of the count into the latches in the 3814. The stored count is then directly proportional to the ratio I_x/I_s. When the count reaches 20,000, the analog circuitry can be reset to zero.

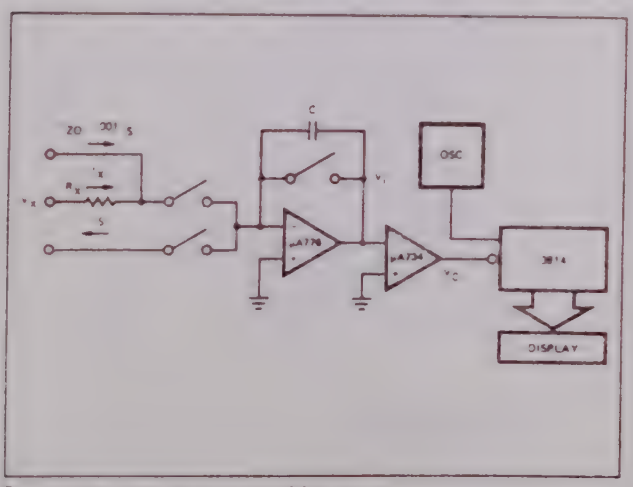


Fig. 3. Simplified schematic of front end.

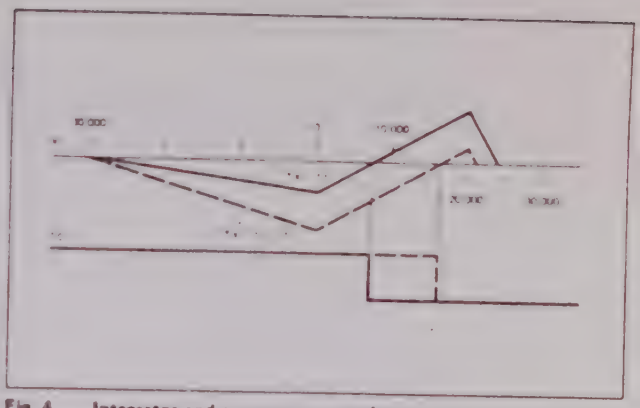


Fig. 4. Integrator and comparator waveforms.

A glitch may occur in the null detector output when it changes state or during an analog reset. To prevent false loading of a count into the storage latches, the transfer input is accepted only once during the interval 00,000 to 39,999. Any transfer commands after the first one are ignored.

The control for the various periods of integration can be obtained from the Q_{E1} and Q_{E2} outputs of the 3814. A "11" state means the unknown should be integrated, an "XO" means the standard should be integrated and a "O1" means the reset period is present. (The circuitry need not be reset here if a DVM capable of displaying 0, 1 or 2 in the most significant decade is desired. In this case, the analog signals must be rapidly reset at count = 30,000.) If only a 0 or a 1 in the most significant decade is required, a transfer occuring during the interval 20,000 to 30,000 indicates overflow. This can be detected by the Q_{E2L} output, which will be high if a count greater than 19,999 was stored in the latches. This can be used to indicate overflow, to automatically up-range, and to blank the display by means of the BLANK input. Forcing MASTER PRESET (MP) sets the internal counters to 30,000 on the next clock pulse.

The ÷2000 output can be used to down range in an autoranging instrument. If this output has not yet gone high when the transfer is received, then the count is less than 10% of full scale (count <1000).

The data outputs are designed to drive a multiplexed display system. A single decoder/driver (such as the 9315 BCD to 1-of-10, or the 9327 BCD to 7-segment) is connected to the O_1, O_2, O_4 and O_8 outputs. The outputs of the decoder drive *all* the display devices. The O_A, O_B, O_C, O_D and O_E outputs drive transistors which select the desired digit. The BCD will have one quarter unit load left over which can be used to drive a low power TTL latch (93L00) or register if parallel BCD data is desired as an additional output of the DVM.

The STEP input, which drives the output multiplexer, can be driven directly from the ÷100 output or can be driven by a separate oscillator.

ZERO OFFSET

An analog glitch also occurs when the integrator input is switched from I_x to I_s. If the input voltage is near zero, the integrator output is close to the null line at the end of the integration. The glitch might cause false triggering of the null detector. For this reason I_{ZO} adds a quantity of charge equal to ten counts of I_s during the integration of the unknown voltage V_x as shown in Figure 3 and Figure 5. This fixed offset guarantees that the integrator output moves away

from the null even if the input voltage is zero. When the counter on the 3814 reaches 40,000 (00,000) the counter remains at zero for ten counts, thus subtracting out the extra ten units of current added during the integration of the unknown voltage.

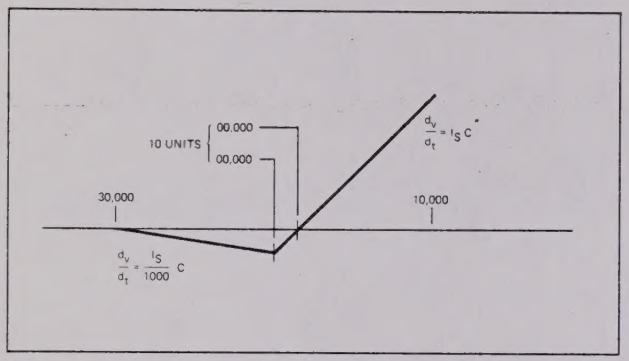


Fig. 5. Integrator output when $V_X = 0$ showing desired zero offset.

LINE REJECTION

Line rejection is important for measuring voltages from high impedance sources. As shown in Figure 6, any 60 Hz components contained in the unknown voltage have an average voltage of zero only if the sample period is some harmonic of 60 Hz. Since the sample period of the 3814 is 10,000 clocks, a suitable clock frequency would be 600,000 Hz for good line rejection. This would give a sample rate of 15 Hz and an output multiplex rate of 6 kHz if the ÷100 output is used as the STEP input.

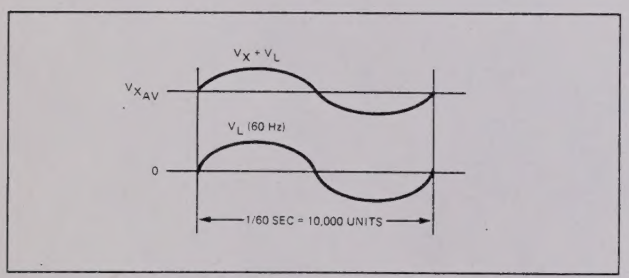


Fig. 6. Line rejection.

DECIMAL POINT

The position of the decimal point in the display is selected by an external switch. For zero suppression, the DP input of the 3814 must be driven by one of the five DIGIT SELECT outputs. This feedback inhibits the zero suppression for that decade and all remaining decades to the right. If the DP input is tied to V_{SS}, all digits are displayed. Tying DP to V_{DD} has the same effect as tying it to output O_E. The different possibilities are shown in Figure 7.

DIGIT FED BACK	COUNT	DISPLAY *
A, or DP = V_{SS}	00000	0
A, or DP = V_{SS}	00120	120
B	00120	12.0
C	00120	1.20
D	00120	0.120
E, or DP = V_{DD}	00120	0.0120
		E DCBA

*The decimal point itself in the display is not controlled by the 3814.

Fig. 7. Decimal point positioning.

EXPANSION TO 5 1/2 DECADES

To increase accuracy, additional decades can be added using standard MSI components. Figure 8 shows the extra devices needed to realize a 5 1/2 digit system.

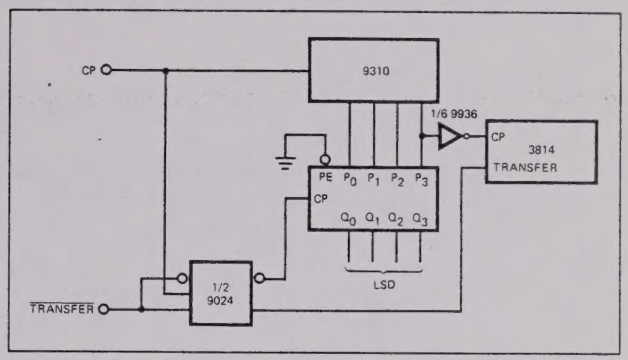


Fig. 8. Modification for 5-1/2 decades.

UNDER RANGE INDICATOR

For input voltages less than 10% of full scale, an under range signal can be generated by gating Q_{E1}, Q_{E2}, the ÷2000 output and the analog comparator output. Figure 9 shows circuitry required for a constant output which can be used to turn on a Light Emitting Diode or as a control signal for auto-ranging circuitry. A pulsed output is shown in Figure 10.

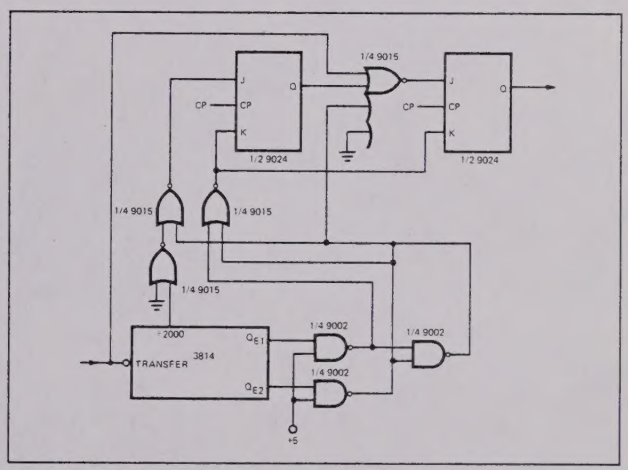


Fig. 9. Under range indicator.

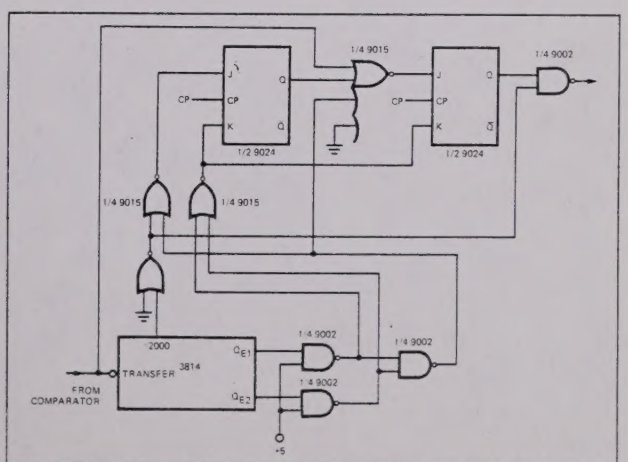


Fig. 10. Blinking under range indicator.

BLANKING BETWEEN DIGITS

While the outputs are multiplexed to the various digits, interference may appear depending on the type of display and the multiplex rate. Figure 11 shows a self-driven blanking scheme to assure that the segment select inputs are stable prior to digit select

GAS DISCHARGE DISPLAY

The BCD outputs of the 3814 will directly drive the 9315 1-of-10 decoder for systems using NIXIE* display tubes. Figure 12 shows the circuit required. For detailed information, see Fairchild Application Note 212 on digital display systems.

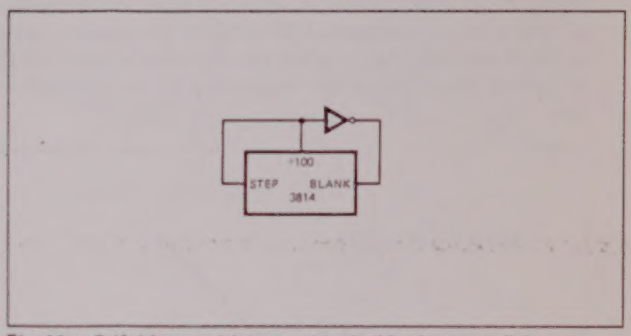


Fig. 11. Self-driven multiplexer with blanking between digits.

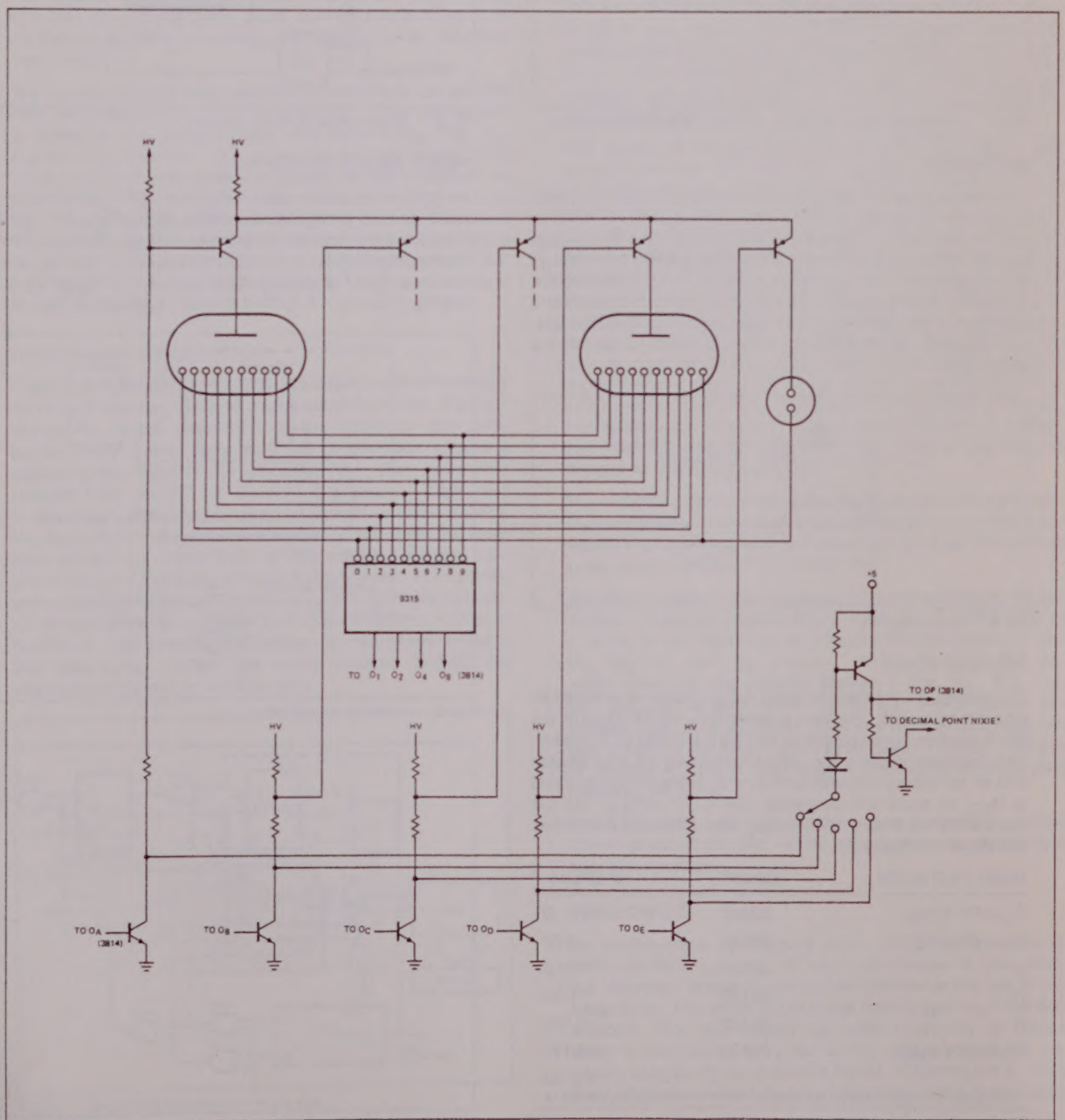


Fig. 12. NIXIE* output.

*NIXIE is a registered trademark of the Burroughs Corp.